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Fabrication & Development of Agriculture Sprayer Vehicle with Solid Fertilizer

Mr.C.Subhahan Basha ¹, Gudipalli Satishkumar ², C.Sankar reddy ³, Shaik Mahal Shakir ⁴,
Bestha Raju ⁵

Assistant Professor, Department of Mechanical Engineering, GATES Institute of Technology Gooty,
Andhra Pradesh, India¹

UG Students, Department of Mechanical Engineering, GATES Institute of Technology Gooty,
Andhra Pradesh, India²⁻⁵

ABSTRACT: Majority of the sprayer pumps available in market are back mounted, hand pumps that are used to spray pesticides. Pesticide spray pump have to be pumped manually and then carried on the back for spraying in the fields. Agriculture sprayer vehicle operates the pump automatically as it moves, pump is mounted on vehicle so no stress to operator, very low cost. 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. Earlier designs were wither top mounted piston handle pumps or side mounted handle piston Pumps.

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. Pump is carried on the moving vehicle, the vehicle is provided with two additional mechanism namely to uniformly spray the pesticides on the crop and secondly a solid fertilizer sprayer with the help of wheel motion.

The solid Fertilizer spread to surroundings through the motion of centrifugal spreader disks. These spreader disks operated by the motion of front wheel of the vehicle. When the vehicle moves the gears transfer the motion through chain and the spreader disks rotates and spread the solid fertilizer.

KEYWORDS: Cost effective equipment, Solid fertilizer sprayer, Liquid fertilizer sprayer, Sprayer Vehicle, Solid and Liquid fertilizer sprayer.

I.INTRODUCTION

In the recent days it has been found that farmers are unable to gain more crop production by use of conventional agricultural methods. So there is big need for the development of engineering system for compensating these drawbacks. It is well known that by using farm equipment's, farmer's yields more crop productions which ultimately have impact on national economy. Itself it gives prior need of Agro equipment's in the field of agriculture. As we can see today, the major problem faced by the farmers is shortage of labour's and also the time required for Fertilization is more. So in order to have solution to it, it was proposed to manufacture a Fertilizer Spreader machine. So, the farmers can work more easy and functional.

Farming is the backbone of Indian economy. In India generally conventional methods of farming are used due to this efforts and manpower required is more. Also spraying pesticides plays vital role in farming industry. In conventional methods, the pesticide sprayer is mounted on the back which causes the back pain and also improper spraying of pesticides. In markets battery operated and fuel operated pesticide sprayer are available. But this also requires some external source of energy and increases cost of production. To overcome all the above difficulties, we proposed design of wheel operated pesticides sprayer. In this method, we convert rotary motion of wheel into reciprocating motion of piston in pump. Several concepts of pesto -sprayer in farming are described as follows. Mohammad Ahmad, Borkar, Ghatole [1] Uses concept of manually operated multi nozzle pesto sprayer to cover maximum area in minimum time.

Patil, Ikile, Jangate, Patil, Nalawade [2] it focused on spraying pesticides at maximum rate in minimum time by using Pedal operated mechanism. Fabricated in minimum cost and easy to handle. Jhod, Jumle, Apte, Borkar [3] Uses Whitworth mechanism to convert rotary motion in reciprocating motion for pest management to minimize the risk for the user Kolhe, Gajbhaye [4] Implementing soil coulters along with spray pump to get double advantage. Sandeep H. Poratkar, Dhanraj R. Raut [5] as suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate. Shailesh Malonde [6] they developed a multipurpose pesticide spraying machine based on solar panels. It gives maximum work output with minimum effort. The arrangement of nozzles is adjustable according to the crops and this alone pump can be used for multiple crops. Shivaraja Kumar Parameswaramurthy [7] 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 and also peddling the equipment. The aim of the project is to reduce the human efforts, save the fuel, time and cost during the spraying of pesticides in the farm.

1.1 UREA FERTILIZER

- Solid fertilizers are manufactured in two main forms; i. Pilled materials where particles are formed in a molten state and are largely spherical.
- Pills usually have a narrow size distribution but there is a practical limit to their mean size. ii. Granular materials are slightly more irregular in shape. They can be larger but usually have a wider size distribution. Because the physical properties of fertilizers, such as density and particle size, have an influence on their spreading performance,
- The SP quality assurance scheme for straight nitrogen fertilizers was developed (Miller 1996). The scheme utilizes a combination of standardized laboratory tests, measurements using an indoor test rig to simulate the performance of a standardized spinning disc unit.
- It was developed using a combination of particle trajectory modelling, and distribution tests carried out in halls and in the field.
- This project draws on the experience gained from that work and other more recent developments to investigate the spreading performance of urea based fertilizers.

II. LITERATURE REVIEW

S. Ramchandra.

Studied that, in India 73% of population is directly or indirectly depends upon the farming. Till now our farmers are doing farming in same traditional way. The main objective of fertilizer broadcaster at sowing time is to uniformly distribute the fertilizer over entire field.

Arun Abraham.

Studied that, conventional spreading of fertilizers for small scale farming are by hand. The farmers have to carry heavy bags throughout the spreading process. So it is necessary to develop a fertilizer spreader for small scale farming.

Joao P.A.R. Cunha

Studied that, the quality of fertilizer distribution process is important to the success of agriculture. This research aimed to study the distribution uniformity of fertilizers with spreaders capable of performing variable rate. Evaluations were carried out in different farms, in the Southwest region of the State of Goias, Brazil.

Studied that, the quality of fertilizer distribution process is important to the success of agriculture.

There are different researchers who invented different types of fertilizer spreading machines. They publish their papers and the papers published are given below:

Chaudhari et. al

[1] studied the sugarcane plantation in India and need of an alternative to the traditional as well as tractor operated fertilizer spreading machine. In India near about 70% people of our country are farmers. Due to these reasons the author developed

the machine which has minimal capital cost compared to traditional fertilizing equipment. Laghari et. al.

[2] focuses on beneficial uses of fertilizer in agriculture. Soil contains various micro and macro elements which are essential for plant growth and yield. It is necessary to save important nutrient elements like nitrogen, phosphorus and potassium by application of chemical fertilizers. For certain situations broadcast applications can be an inefficient method of application because there is much greater soil to fertilizer

III. PROBLEM STATEMENT

Generally in the manually spreading of the fertilizers in the farm, some of the problems are occurring like uneven spreading of the fertilizers (wrong stuff and wrong amount) which may result in the crop damage. Conventional spreading of fertilizers by hand in a farm is more time consuming method and require more human effort. So Urea spreader machine is suitable more for agriculture work as it will improve crop production easily and with minimum efforts. Earlier operated back mounted agriculture sprayer pump are less efficient. The area covered by them is also less. By using tractor sprayer there is significant increase in soil pollution and also reduces the productivity of the soil. This problem statement also focuses on social impact. This model requires less hard work as compared to back mounted sprayer and less cost as compared to tractor sprayer. The problem focuses on welfare of farmers and bringing social impact..

IV. WORKING PRINCIPLE

It is based on motion of ground wheel using gear arrangement. The flow of fertilizer is maintained by using spring mechanism.

It is a machine for spreading the fertilizer in continuous and controlled flow at uniform rate. It can cover an acre of farm within half an hour.

On rotor, Hooper is located to reservoir of fertilizer, of which flow is controlled by spring mechanism. The control of spring mechanism is under control of operator.

This machine is operated is operated using a motion of ground wheel through gear transmission arrangement.

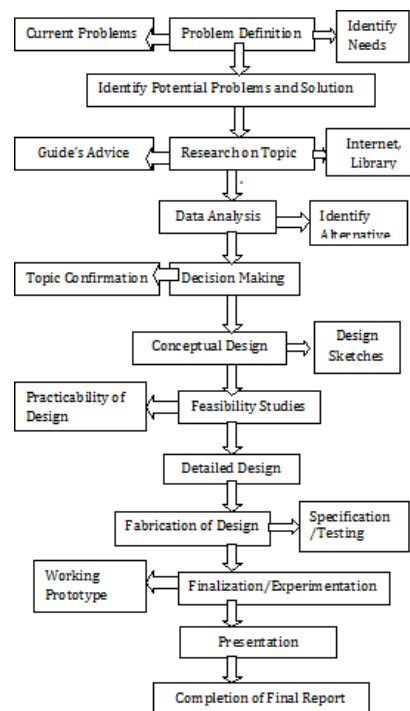
The flow of fertilizer is controlled by spring mechanism.

The system consists of a three wheels, two at the front and one at the back. These two wheels

Hopper is placed at some height from the wheel axle so that the fertilizer falls on to the impeller.

The hopper is provided with flow control mechanism. In fertilization, the flow maintenance is necessary. Generally every crop should get sufficient amount of fertilizer. This condition is satisfied by Spring Mechanism

The system consists of a three wheels, two at the front and one at the back. These two wheels at the front are used to impel the fertilizer.



Below this system there is an impeller. It is mounted on output shaft. Hooper opens on Impeller eccentrically and due to centrifugal action fertilizer spreads in the farm.

This high value of centrifugal force is generated by the help of proper gear reduction ratio. The gears are coupled to the shaft of wheel with this machine.

Percentage reduction in time required for Fertilization was observed to be 50% and reduction in labor cost as compared to conventional method was 80%. It has solved the problem of traditional way of Fertilization.

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Fig 1: Urea Spreader Machine Model

5.FRAME

The frame works as a supporting structure. The Aluminium material used for making a frame. At bottom of the frame wheel are attached.

The frame consist of three wheels and Aluminium material the wheels are used for move the vehicle. The vehicle has to move in the field for spreading solid fertilizer and spraying pesticides. The rotating disk rotated by the gear and chain mechanism attached to it. When solid fertilizer like urea falls on the rotating disk the disk spreads the fertilizer to the surroundings. For transmitting horizontal rotating motion into vertical rotatory motion pinion gears are used. The pinion gears transfer the rotatory motion.

The back side of the vehicle is placed a pesticide sprayer which is automatically operated by the rear wheels. The rotary motion of the rear wheels is converted into reciprocated motion which is helps to increase the pressure in the pesticide sprayer. The piston of the pesticide sprayer is connected to the reciprocating motion due to this the pressure in the sprayer increases and sprayer the liquid out with high pressure.



Fig 2 : Frame

VLHOPPER

Hopper is used to keep fertilizer. Hopper is used for convey the fertilizer to the rotating disc. In this machine material used for hopper is PVC. Flow control mechanism is provided in hopper.

A **hopper** is a large, pyramidal or cone shaped container used in industrial processes to hold particulate matter or flowable material of any sort (like dust, gravel, nuts or seeds) and dispense these from the bottom when needed. In some specialized applications even small metal or plastic assembly components can be loaded and dispensed by small hopper systems. In the case of dust collection hoppers the dust can be collected from expelled air. Hoppers for dust collection are often installed in groups to allow for a greater collection quantity. Hoppers are used in many industries to hold material until it is needed, such as flour, sugar or nuts for food manufacturing, food pellets for livestock, crushed ores for refining, etc. Dust hoppers are employed in industrial processes that use air pollution control devices such as dust collectors, electrostatic precipitators, and baghouses/fabric filters. Most hoppers are made of steel.



Fig 3 : Hopper

VII. ROTATING DISK

Rotating disc is look like impeller. It is mounted on rotating shaft. Hopper opens on rotating disc eccentrically and due to centrifugal force fertilizer spread in farm.

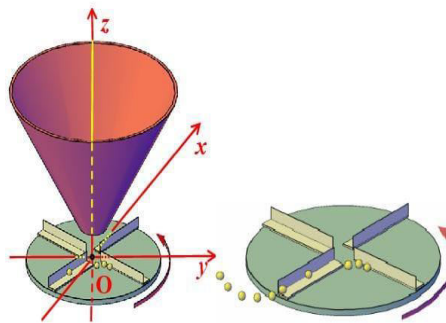
Specification

Length = 20.32 cm

Thickness = 0.5 cm

The considered disc fertilizer spreader consists of a single rotating disc having two straight vanes mounted on it. A hopper having a dosing outlet and a stirrer feeds the disc with the fertilizer. Usually, the fertilizer is thrown away from the disc-vanes device with a speed v_e that ranges between 15–50 ms⁻¹ with a maximum value that, in some case, can reach 70 ms⁻¹ with higher speeds related to wider working widths. The fertilizer particle eject speed is directly related (Figure 1) to the angular speed of the disc ω_d and to specific design factors of the spreader itself such as: (i) the disc radius r_d ; (ii) the fertilizer feed point radius r_0 ; (iii)

the angle between each vane and the corresponding radius (pitch angle β_0) and (iv) the cone angle of the rotating disc. Taking into account the D'Alembert's Principle, the motion of a single fertilizer particle is described by a differential equation which considers all the forces that act on it [25]. Among these forces, the friction force plays a significant role in the present study. It depends on the particle weight and on the fertilizer physical characteristics. An increase of the friction force due mainly to an increase of the friction coefficient between the fertilizer particle and the disc-vanes device, leads to both a lower eject speed v_e and a smaller eject angle θ .

**Fig 4: Rotating disk**

The most common method for distributing dry mineral fertilizer is with a fertilizer spreader. In a sustainable framework, economic and political aspects also have to be considered in order to achieve the best possible maintenance of environmental and natural resources. A sustainable economy requires the conservation and maintenance of the natural soil environment, in which the leading objective must be improvement of soil sorption properties and the maximum possible increase in humus content, which is influenced among other things by the soil cultivation method. Many aspects of this issue depend on the plant cultivation technology, the subsequent processing phase and how biomass used for energy production is stored. In each of these areas, occupational safety is also important and requires farmers to specialize. This increases production quality, sustainability and compliance with local and international regulations. A major technical problem in agriculture, directly related to increasing production in sustainable agriculture, is optimization of the construction of agricultural machinery to increase its reliability and efficiency. Liquid and granular fertilization are both greatly affected by the shape and uniformity of fertilizer distribution on the soil. Fertilizing fields at the recommended doses, adjusted for soil nutrient content and plant requirements, is of paramount importance for obtaining high-quality crops. Any error in the fertilization phase, such as excessive doses and wrong proportions of elements, can cause pollution and environmental degradation. In this framework, mathematical models can be used to improve the performance of agrotechnical operations by testing the different solutions for machinery with the given technical and operational characteristics. For mineral fertilizer spreaders, basic information on these characteristics is provided by tests of spread lateral and longitudinal unevenness. Research on uneven distribution of fertilizers is conducted around the world according to standardized methodological recommendations.

VIII. BEVEL GEAR

The standard definition of a Bevel Gear is a cone-shaped gear which transmits power between 2 intersecting axels.

Looking at bevel gears from the differences in helix angles, they can be generally classified into straight bevel gears, which do not have helix angles, and spiral bevel gears (including zerol bevel gears), which do have helix angles. However, because of the fact that manufacture facilities for straight bevel gears are becoming rare and the fact that straight bevel gears teeth cannot be polished, making spiral bevel gears which can be polished superior in terms of noise reduction, spiral bevel gears are likely to become more common in the future.

Bevel gears can be generally classified by their manufacturing methods, namely the Gleason method and Klingelnberg method, which each have differing teeth shapes, and presently most gears use the Gleason method. Incidentally, all gears manufactured by KHK use the Gleason method.

Furthermore, there are also variations in gears in terms of teeth pitch (modules, etc.), whether polished or not, and materials used. For example in the case of materials, S45C of machine structural carbon steel, SCM415 of machine structural alloy steel and MC901 of engineering plastic, etc. are often used, and duracon, etc. are used for plastic molded parts.



Fig5 : Bevel Gear

Two important concepts in gearing are pitch surface and pitch angle. The pitch surface of a gear is the imaginary toothless surface that you would have by averaging out the peaks and valleys of the individual teeth. The pitch surface of an ordinary gear is the shape of a cylinder. The pitch angle of a gear is the angle between the face of the pitch surface and the axis.

Bevel gears are classified in different types according to geometry:

- Straight bevel gears have conical pitch surface and teeth are straight and tapering towards apex.
- Spiral bevel gears have curved teeth at an angle allowing tooth contact to be gradual and smooth.
- Zero bevel gears are very similar to a bevel gear only exception is the teeth are curved: the ends of each tooth are coplanar with the axis, but the middle of each tooth is swept circumferentially around the gear. Zero bevel gears can be thought of as spiral bevel gears, which also have curved teeth, but with a spiral angle of zero, so the ends of the teeth align with the axis.

Hypoid bevel gears are similar to spiral bevel but the pitch surfaces are hyperbolic and not conical. Pinion can be offset above, or below, the gear centre, thus allowing larger pinion diameter, and longer life and smoother mesh, with additional ratios.

IX. PRESSURE TANK

India is a country whose economy is mainly based on agriculture. Most of the people of our country are farmers. Main aim of this paper is to reduce human efforts and also support small scale farmers who cannot afford expensive equipment's for farming.

Main purpose of sprayer is to spray pesticides and fertilizer. But this proposed solution can perform two operation at time and is cost effective. Basically, many farmers in India uses traditional method for farming. This will not satisfy need of energy requirement of the farming as compared to other countries in the world. So we are thinking that human and animal efforts can be replaced by some advance mechanization which will be suitable for small scale farmer from economical and effort point of view.

A sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors with boom mounts of 4–30 feet in length depending on engineering design for tractor and land size.



Fig 6 : Pressure tank

Sprayers are fully integrated, mechanical systems, meaning they are composed of various parts and components that work together to achieve the desired effect, in this case: the projection of the spray fluid. This can be as simple as a hand sprayer attached to a bottle that is pumped and primed by a spring-lever, tube, and vacuum-pressure; or as complex as a 150 foot reach boom sprayer with a list of system components that work together to deliver the spray fluid.

For more complex sprayers, such as agricultural sprayers, common system components include: the spray nozzle, sometimes with a spray gun, fluid tank, sprayer pump, pressure regulators, valves and gaskets, and fluid plumbing. The sprayer pump can be just as important as the sprayer type itself as there are many sprayer pump design types with various construction materials, inlet/outlet sizes, and performance specifications. Common sprayer pump types include diaphragm, centrifugal, and roller pumps.

X.ADVANTAGES AND LIMITATIONS

10.1 ADVANTAGES

- Time savings
- Less fatigue to labour.
- High speed Fertilization.
- Applicable for small and medium farms.
- No electric power required.
- Easy to operate, as no skilled operator required.
- Easy to assemble.
- It is pollution free.
- Maintenance cost is low.

10.2.LIMITATIONS

- Machine requires more effort in hard soil.
- Operating force varies from person to person.
- It is manually operated, so it is difficult to run continuously



XI. CONCLUSIONS

The main objective of our project was to fulfil the need of farmers suffering from the problems of increasing cost of Fertilization, labor cost and availability as it is operated by single person. The draw backs in the existing spreader models are reduced in this system. It has solved the problem of traditional way of fertilization by saving almost 50 % time. Also this machine is ecofriendly, easy to operate with low capital cost and less troubleshoots.

Many spraying devices are present in market today. But the back mounted pump increases the hard work. The cost of tractor sprayer is high, which cannot be afforded by small scale farmers. The design and model created focuses on reducing human efforts. This solution is not so expensive also. Unlike tractor fertilizer there is no wastage of fertilizer and pesticides. There is no decrease in productivity of land. Comparative study of old and created model shows that this solution is efficient and covers more land than back mounted sprayer.

REFERENCES

- 1.S.C.Jain, "FarmMachinery-AnApproach", PP-5,36,45
- 2.D. S. Sharma and Mukesh Sharma, "Farm MachineryDesignPrinciplesand problems", PP-225-245.
- 3.R.S. Khurmi , J. K. Gupta, "Machine Design", S. ChandPublicationsNew Delhi,1st edition,2010 PP-387-390,510-512, 766-774
4. H. Landry, F.Thirion, C.Lague, M. Roberge, "Numerical modeling of the flow of organic fertilizers in land application equipment", science direct, Computers and Electronics in Agriculture 51 (2006).
- 5.Hao Lv, Jianqun Yu, Hong Fu, "Simulation of the operation of a fertilizer spreader based on an outer groove wheel using a discrete element method", science direct, Mathematical and Computer Modeling 58 (2013).
- 6.Teddy Virin, Jonas Koko, Emmanuel Piron, Philippe Martinet, "Application of Optimization Techniques for an Optimal Fertilization by Centrifugal Spreading", IEEE (2006).
- 7.Pratik P. Patil, Suyog S. Patil, Sumit M, Sonwane, "Solar Operated Solid Fertilizer Dispensing Machine" ,National conference on Emerging trends in Engineering and Technology(2018).
- 8.Akhil P T, Aravind M. G., Arjun S Balan, Arun Abraham, Sajeev A, "Design and Fabrication of Trolley Mounted Fertilizer Spreader", International Journal for Innovative Research in Science &Technology, April 2017
- 9.Narode R. R. ,Sonawane A. B. , Mahale R. R. , Nisal S. S. , Chaudhary S.S. , Bhane A. B. , " Manually Operated Fertilizer Spreader", International Journal of Emerging Technology and Advanced Engineering.



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