Design and Analytical Calculation for Portable Agricultural Sprayer, Weeder with Cutter

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Abstract- India is said to be an agricultural based country approximately 75% of population of India is dependent on farming directly or indirectly. Farmers are using the same methods and equipment for the ages. In our country farming is done by traditional way, besides that there is large development of industrial and service sector as compared to that of agriculture. The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort. The weeding is the generally done with the help of Bulls which becomes costly for farmers having small farming land also cutting of unwanted grass is done by individual sickle which requires human effort and time. So to overcome these above three problems a mechanism is developed which will be beneficial to the farmer for the spraying, cutting and weeding operations.

Keywords-weeding, sprayer, cutter, sickle.

1. INTRODUCTION

Agriculture is the backbone of Indian economy. India being developing nation agriculture and industries summer, one or more types of sprayers will be used by based on agriculture products has prime importance in the average home gardener. Of the many products the national economy. Majority of the Indian population available, it is important to select the most efficient and depends on agriculture and agro-based industries and easiest type for your particular need, whether it is for businesses.

operations namely "Spraying, Weeding & Cutting". For is made especially for the application of liquid materials Spraying pesticides, the reservoir tank contains to the lawn area. They are metered to allow quick pesticides is attached to the reciprocating pump. The mixing and coarse spray, so it does not take as long to outlet of the pump is connected to the spraying nozzle apply weed killers, insecticides, etc. Also, there is not through flexible pipe. A cutting plate is attached just as much chance of drift of the liquid into nearby flower below the reservoir tank for the weeding purpose. By and shrub beds. The old saying "You get what you pay using a reciprocating pump the liquid enters a pumping for" certainly applies to sprayers. Efficiency and chamber via an inlet valve and is pushed out via an accuracy vary considerably, especially with the type outlet valve by the action of the piston or diaphragm. that attaches to the garden hose. Sprayers that are used The hydraulic spray nozzle used in the application of for weed killing or for applying any type of soil sterility pesticides has several functions. One of its main should not be used for any other purpose. In fact, you purposes is to convert the spray solution into droplets will find it a good practice to set a sprayer aside just for for efficient target coverage.

rotate on an axial bearing. A crank is an arm attached at immediately after you have used it for any type of right angles to a rotating shaft by which reciprocating spraying. A little soapy water, swished around and motion is imparted to or received from the shaft. The through sprayer, then flushed out with warm water, belts are used to transmit power from one shaft to does good job.. another by means of pulleys which rotate at the same speed or different speeds. Reciprocating pumps are 2.2 Weeder used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid agriculture. Chemical method of weed control is more flow.

2. LITERATURE REVIEW

2.1 Sprayer

In an average year, especially during the applying insecticides fungicides, weed killers, liquid The equipment is designed to perform the three fertilizers or wetting agents. For example, lawn spraver the lawn area. Use a separate one for flowers and A wheel is a circular component that is intended to shrubs. It is a good practice to clean out your sprayer

Weed removal is one of the major activities in prominent than manual and mechanical methods. Chemical weeding is themost extensively used method of weed removal but these chemicals used for weeding

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are harmful to living organisms and toxic in nature. level below the suction flange even if the suction pipe is Research has been carried out to use some combination not evacuated. The pump delivers reliable discharge various methods of weeding. The need of replace the flows and is often used for metering duties delivering use of herbicides with more sustainable weed control accurate quantities of fluid.

techniques encouraged the definition of innovative physical weed control strategies. Weed removal by mechanical method is one the methods frequently used these to remove weeds from the agricultural fields. Weeding Machines designed and developed with intent of being operated in specific crops like tomatoes, corn, and rice. These machines are mostly intra row weeding machines which remove weeds within multiple crop rows at once. Weeding machines like three row walking type one were developed and successfully to remove weeds from rice.

Sensors like laser sensors are used some machines to differentiate the weeds from crops and 3.1.2 Storage tank increase the effectiveness of weeding. Studies have been conducted on the effect of moisture content and the type of cutting blades like flat blades, spike tooth blades and curved blades on the performance of weeding machines. Mechanical weeding was found to be less effective when soils are wet during or after the weeding operation

2.3 Cutter

A sickle is a hand-held agricultural tool with a variously curved blade typically used for harvesting grain crops or cutting succulent forage chiefly for feeding livestock (either freshly cut or dried as hay).A great diversity of types is used across many cultures.

3 COMPONENTS

3.1 Basic components of sprayer

3.1.1Pump

A pump is a device that moves fluid (liquid or gases), or something slurries, by mechanical action. Any spray liquid must be atomized before leaves the spray nozzle. The pump facilitate the necessary pressure for this purpose.

Types of pump:

1) Air Compression or Pneumatic pumps:

These pumps force air into an airtight tank containing spray liquids thus moving the spray liquid under pressure through the nozzle for its atomization.

2) Hydraulic or Positive Displacement Pump:

These pumps take in a definite volume of spray liquid and force it through the delivery system under pressure. The pumps differ in pressure they produce.

2 *Reciprocating pump*

reciprocating piston. The liquid enters a pumping increase velocity) as it exits (or enters) an enclosed chamber via an inlet valve and is pushed out via an chamber or pipe. Agricultural chemical can be applied outlet valve by the action of the piston or diaphragm. according to The American Society of Agricultural and Reciprocating pumps are generally very efficient and Biological Engineers (ASABE) Standards (2006) by are suitable for very high heads at low flows. This type broadcast application that uses spray over an entire field of pump is self-priming as it can draw liquid from a and band application that uses spray in parallel bands



Fig1.Reciprocating pump



Fig2.Storage tank

Storage tank are container that holds liquid, compress gases (gas tank) or medium used for short or long term storage of heat or cold. Storage tanks are available in many shape & size, like vertical & horizontal cylinder ,open top & close top, flat bottom & cone bottom etc. A sprayer may have either a built in tank or separate tank to carry spray liquid. The tank need be large enough to avoid frequenter filling but not cumbersome to carry. The tank is equipped with a large opening with a built in strainer and cap to fill in the liquid. Small openings pose difficulty in filling and cleaning the tank.

The storage tank is connected to reciprocating pump by using flexible pipes which carries pesticides toward the nozzle.

3.1.3 Nozzle

A nozzle is a device designed to control the These types of pump operate by using a direction or characteristics of a fluid flow (especially to

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leaving areas between the bands free of chemical. productive tillers.Large panicle size, more number of Chemical control in row crops is typically carried out as grains per panicle and increased grain weight.

a broadcast application by using standard flat fan nozzles and most farmers use this kind of application because it is the easiest and preferred method.



Fig3.Nozzle

3.1.4 Wheel

A wheel is a circular component that is intended to rotate on an axial bearing. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labor in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel.



Fig4.Wheel

3.1.5 Weeder

A device, as a tool or machine, which is used for Velocity Ratio (Sprocket C to D) = Tc/Td=Nd/Ncremoving, weeds, weeding was considered a major V.R. = 43/18 = 2.38constraint in crop production. Weeder enhances the Velocity Ratio (sprocket A to D) = Ta/Td=Nd/Na utilization of biomass. Weeder facilitates proper V.R.(Ato D) = $2.38 \times 1 \times 2.38 = 5.664$ aeration in the soil. Weeder promotes healthy growth of Now, for RPM of Outer Wheel connected to sprocket D the root system and consequently the plant. We eder is a $Nd = V.R.(Total) \times Na$ device which Provides earthing up effect facilitating plants to produce new roots which help additional nutrients uptake Increased yields as a result of more Now,

3.3.6 connecting link:-



Fig5. Connecting Link

The connecting link is a chain link having a movable section so that it can be used to unite two sections of chain

4 ANALYTICAL CALCULATIONS:-

Reciprocating pump:-



From figure,

Na = RPM of sprocket A =25 (Under Normal condition)

Nb=RPM of sprocket B

- Nc= RPM of sprocket C
- Nd= RPM of sprocket D
- Ta = Number of Teeth on sprocket A = 43
- Tb = Number of Teeth on spocket B = 18
- Tc = Number of Teeth on sprocket(sprocket3)C = 43
- Td = Number of Teeth on sprocket(sprocket4) D= 18
- a = Length of connecting rod = 420 mm

Now.

Velocity ratio (sprocket A to B) = Ta/Tb=Nb/Na V.R.(1 to 2) = 43/18 = 2.38

Similarlly

Velocity Ratio (sprocket B to C) = 1(mounted on same shaft)

 $= 5.6 \times 25$

= 140 rpm

Discharge Q = LAN/60 for Single acting

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Q = 2LAN/60 for Double acting L=stroke length of reciprocating pump(m) = 180 mm A=cross sectional area of reciprocating pump N=rpm of crank

 $Q = 2 \times 180 \times \pi \times 65 \times 140/4 \times 60$ =2× 1.39 m³/s = 1.39×60 = 166.8 m³/min =166.8/1000 Lit/min Q = 0.1668 Lit/min This is the discharge through one nozzle For two nozzles discharge Q = 0.1668/2 = 0.0834 lit/min

Specifications of Machine:-

S	Titles	Values
r		
1	Wheel Diameter	50 cm
2	Pump Stroke per rotation of wheel	2
3	Pump in ideal condition, rate of discharge	1 lit/min
4	In working condition, rate of discharge	0.1668 lit/min
5	Rotation of wheel per minute	25
6	Delivery of pesticide liquid per rotation	25 ml
7	Delivery of pesticide per stroke of pump	8.33 ml
8	Delivery of pesticide from 2 nozzles	80 ml/stro ke
9	Delivery of pesticide per nozzle	2.08 ml/stro ke

By Traditional Method	By Proposed
	machine
Labor cost	Labor cost
=Rs 400 per day	=Rs 200 per day
Cost of pump	Discharge through
=Rs 3000 - 4000	sprayer
A labor can spray 3 acre	=1 litre per min.
of land in one day	Our equipment can
	spray 6 acre of land
	per day
For 3 acre of land	For 6 acre of land
= 3* 1750 + 400	Total cost=6*cost of
= Rs 5650	pesticide + labor
For 6 acre = $2 * 5650 = Rs$	cost
11300 (in two days)	=6*1750+200
	=Rs 10700 (in one
	day)

5 WORKING:-

• When the equipment is push forward by using handles, front wheel rotates and the gear is mounted at the axle of wheel is start to rotate and its rotation is then transferred to the pinion through the chain drive.

• The rotary motion of the pinion is converted into the reciprocating motion by the single slider crank mechanism, due to this arrangement the connecting rod moves upward and downward which then reciprocate the piston of single acting reciprocating pump mounted at the top of storage tank.

• During the upward motion of the connecting rod the pesticide is drawn into the pump and during the downward motion of connecting rod the pesticide is forced to the delivery valve, the delivery is connected to the pipe carrying the number of nozzles.

6 NEED OF METHODOLOGY:-

In a research proposal you need a methodology to explain where you are coming from and why you want to do the research in a particular way. Explaining your methodology helps others know why you want to do your research in a particular way. It helps others know that you know what you are doing. It gives confidence to funding agencies that you are not going to waste their money. If your methodology is new, innovative or just plain different then you have to write more of a justification so that others will understand what you are trying to do and why it is important to do it this new way.

In writing about your research i.e. design and development of sprayer, weeder and cutter, when you have completed the project. You need an explanation of your methodology so that others can understand the significance of what you have done and make sense of how it all worked. The methodology piece says why you did, what you did. It also enables you to write about what you did not do and why, and about the weaknesses or limitations of your project (i.e. design and development of sprayer, weeder and cutter) as well as its strengths. Every research has a limitation of some sort and it is perfectly acceptable to identify the weaknesses of your own study.

ADVANTAGES

• Decrease the operational cost by using new mechanism.

• Work reliably under different working conditions.

• Decrease the cost of machine.

• Decrease labor cost by advancing the spraying method.

• Machine can be operated in small farming land (5 acre).

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• Making such a machine which can be able to perform Agriculture Fertilizers and Pesticides Spraying Pump" both the operation (spraying and weeding). IJERT, ISSN:2278-0181,Vol.4 (7).

• So considering these points related to spraying and **CES** weeding an attempt is made to design and fabricate such equipment which will able to perform both the operations more efficiently and also will results in low cost.

CONCLUSION

The equipment is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying as well as weeding at minimum cost for the farmer. The equipment will results more beneficial when it is subjected to moist soil for weeding purpose, due to moist soil the weed cutter can easily penetrate and dig out the soil and hence will easily accomplished the weeding process the cutter can cut small grass levels. This device can efficiently reduces the human effort and more precisely for poor farmers who does not afford the mechanical devices such as tractors.

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