INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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# A REVIEW - SPRAYING METHODS AND WEEDING OF CROPS IN AGRICULTURAL SECTOR.

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**Accepted Date: 15/03/2016; Published Date: 01/05/2016**

**Abstract:** In order to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable. Mechanization enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied. Mechanization reduces unit cost of production through higher productivity and input conservation. 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 labour 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. So to overcome these above two problems a machine is developed which will be beneficial to the farmer for the spraying and weeding operations.

**Keywords:** Mechanization, Back Type Sprayer, Weeding, Modernization

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**Access Online On:**

www.ijpret.com

**How to Cite This Article:**

Hansa Tayde, IJPRET, 2016; Volume 4 (9): 266-282

***PAPER-QR CODE***

## INTRODUCTION

India is set to be an agricultural based country approximately 75% of population of India is dependent on farming directly or indirectly. Our farmers are using the same methods and equipment for the ages. e.g. seed sowing, spraying, weeding etc. There is need for development of effective spraying and weeding machine for increasing the productivity.

### A. Status of agricultural mechanization in India

Most of the developing countries of Asia have the problem of high population and low level of land productivity as compared to the developed nations. One of the main reasons for low productivity is insufficient power availability on the farms and low level of farm mechanization. This is especially true for India. It is now realized the world over that in order to meet the food requirements of the growing population and rapid industrialization, modernization of agriculture is inescapable. It is said that on many farms, production suffers because of improper seedbed preparation and delayed sowing, harvesting and threshing. Mechanization enables the conservation of inputs through precision in metering ensuring better distribution, reducing quantity needed for better response and prevention of losses or wastage of inputs applied. Mechanization reduces unit cost of production through higher productivity and input conservation. Agricultural implement and machinery program of the government has been one of selective mechanization with a view to optimize the use of human, animal and other sources of power. In order to meet the requirements, steps were taken to increase availability of implements, irrigation pumps, tractors, power tillers, combine harvesters and other power operated machines and also to increase the production and availability of improved animal drawn implements. Special emphasis was laid on the later as more than 70% of the farmers fall in small and, marginal category. It is generally said that mechanization of small farms is difficult. But Japan having average land holding even smaller than ours, with proper mechanization has led agriculture to great heights. In order to minimize the drudgery of small farmers, to increase efficiency and save farmer's time for taking up additional supplementary generating activities, the use of modern time saving machines/implements of appropriate size needed to be suitably promoted.

### *B. Research & Development System*

The Indian Council of Agricultural Research (ICAR) is the main organization looking after all agricultural research, including agricultural implements and machinery. It coordinates a number

of research projects with centres at different places in the country. Some of the State Governments have also facilitated in setting up of research organizations at state level. Each of the state has at least one agricultural university. A research program usually concentrates on the development of equipment suitable to a given farming conditions. The objective is to improve upon the of indigenous implements or develop a new implement that can either enhance labour productivity or appropriately mechanize the operation where a labour or power shortage hinders completing the task in time.

## II. LITERATURE REVIEW

### *A. Spraying Methods*

One of the more common forms of pesticide application, especially in conventional agriculture, is the use of mechanical sprayers.

#### *1. Backpack (knapsack) sprayer*

One type of backpack sprayer is a compressed air sprayer with a harness that allows it to be carried on the operator's back. [1] Another type of backpack sprayer has a hand-operated hydraulic pump that forces liquid pesticide through a hose and one or more nozzles. The pump is usually activated by moving a lever. A mechanical agitator plate may be attached to the pump plunger. Some of these sprayers can generate pressures of 100 pounds per square inch (psi) or more. Capacity of both these types of backpack sprayers is usually 5 gallons or less.

**Figure 1: Backpack type spraying**

Hydraulic sprayers consist 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. But, in this type of spraying, the labour has to carry all the weight of the pesticides filled tank which causes fatigue to labour and hence reduces the human capacity.

*2. Lite-Trac*

Lite-Trac is a trading name of Holme Farm Supplies

Ltd, a manufacturer of agricultural machinery registered in England and based in Peterborough. The Lite-Trac name comes from "lite tractor", due to the patented chassis design enabling the inherently very heavy machines manufactured by the company to have a light footprint for minimum soil compaction.

**Figure 2: Lite-trac spraying**

Holme Farm Supplies Ltd agricultural products, sold under the Lite-Trac name, include tool carriers, self-propelled lime and fertilizer spreaders, sprayers, granular applicators and tank masters. Lite-Trac is currently the manufacturer of Europe's largest four-wheeled self-propelled crop sprayers. The company's products are identifiable by the combination of unpaintedstainless steel tanks and booms with bright yellow cabs and detailing. A Lite-Trac crop sprayer, or liquid fertilizer applicator, mounts onto the SS2400 Tool Carrier centrally between both axles to maintain equal weight distribution on all four wheels and a low centre of gravity whether empty or full. The stainless steel tanks are manufactured in capacities of up to 8,000 liters, whilst Pommier aluminium booms of upto 48 meters can be fitted, making these Europe’s largest four-wheeled self-propelled sprayers. [2]

*3. Motorcycle driven multi-purpose farming device (Bullet*

*Santi)*

In 1994, Mansukhbhai Jagani, developed an attachment for a motorbike to get a multi-purpose tool bar. It which addresses the twin problems of farmers in Saurashtra namely paucity of laborers and shortage of bullocks. This motorcycle driven plough (Bullet Santi) can be used to carry out various farming operations like furrow opening, sowing, inter-culturing and spraying operations. Mansukhbhai's intermediate-technology contraption proved efficient and cost-effective for small-sized farms.

**Figure 3: Motorcycle driven spraying**

It could plough one acre (0.4 ha) of land in less than half an hour on just two litres of diesel oil. Using motorbike-santi, the cost of weeding a typical field was found to be just Rs 8/ha because as much as 10 ha land could be covered in a single day. But, this spraying equipment needs fuel for its running and proper operation which increases its operating cost. [3]

*B. Weeding or Weed control*

Weed control is the botanical component of pest control, using physical and chemical methods to stop weeds from reaching a mature stage of growth when they could be harmful to domesticated plants and livestock. In order to reduce weed growth, many "weed control" strategies have been developed in order to contain the growth and spread of weeds.

The most basic is ploughing which cuts the roots of annual weeds. Today, chemical weed killers known as herbicides are widely used.

*1. Exact definition*

There is no universal definition for what qualifies as an obnoxious plant. However, a plant is often termed weed when it has one or more of the following characteristics:

- Little or no value (as in medicinal, nutritional, or energy).
- Very high growth rate and/or ease of germination.
- Exhibits competition to crops, for space, light, water and nutrients.

*2. Effects on other plants*

Weeds can compete with productive crops or pasture, or convert productive land into unusable scrub. Weeds are also often poisonous, distasteful, produce burrs, thorns or other damaging body parts or otherwise interfere with the use and management of desirable plants by contaminating harvests or excluding livestock.

Weeds tend to thrive at the expense of the more refined edible or ornamental crops. They provide competition for space, nutrients, water and light, although how seriously they will affect a crop depends on a number of factors. Some crops have greater resistance than others- smaller, slower growing seedlings are more likely to be overwhelmed than those that are larger and more vigorous. Onions are one of the crops most susceptible to competition, for they are slow to germinate and produce slender, upright stems. Quick growing, broad leafed weeds therefore have a distinct advantage, and if not removed, the crop is likely to be lost. Broad beans however produce large seedlings, and will suffer far less profound effects of weed competition other than during periods of water shortage at the crucial time when the pods are filling out. Transplanted crops raised in sterile seed or potting compost will have a head start over germinating weed seeds.

Weeds also differ in their competitive abilities, and can vary according to conditions and the time of year. Tall growing vigorous weeds such as fat hen (Chenopodium album) can have the most pronounced effects on adjacent crops, although seedlings of fat hen that appear in late summer will only produce small plants. Chickweed (Stellaria media), a low growing plant, can happily co-exist with a tall crop during the summer, but plants that have overwintered will grow rapidly in early spring and may swamp crops such as onions or spring greens. The presence of weeds does not necessarily mean that they are competing with a crop, especially during the early stages of growth when each plant can find the resources it requires without interfering with the others. However, as the seedlings' size increases, their root systems will spread as they each begin to require greater amounts of water and nutrients. Estimates suggest that weed and

crop can co-exist harmoniously for around three weeks, therefore it is important that weeds be removed early on in order to prevent competition occurring. Weed competition can have quite dramatic effects on crop growth. Harold A Roberts cites research carried out with onions wherein "Weeds were carefully removed from separate plots at different times during the growth of the crop and the plots were then kept clean. It was found that after competition had started, the final yield of bulbs was being reduced at a rate equivalent to almost 4% per day. So that by delaying weeding for another fortnight, the yield was cut to less than half that produced on ground kept clean all the time." (The Complete Know And Grow Vegetables, Bleasdale, Salter and others, OUP 1991). He goes on to record that "by early June, the weight of weeds per unit area was twenty times that of the crop, and the weeds had already taken from the soil about half of the nitrogen and a third of the potash which had been applied".

*3. Methods of Weed Control*

In domestic gardens, methods of weed control include covering an area of ground with several layers of wet newspaper or one black plastic sheet for several weeks. In the case of using wet newspaper, the multiple layers prevent light from reaching all plants beneath, which kills them. Saturating the newspaper with water daily speeds the decomposition of the dead plants. Any weed seeds that start to sprout because of the water will also be deprived of sunlight, be killed, and decompose. After several weeks, all germinating weed seeds present in the ground should be dead. Then the newspaper can be removed and the ground can be planted. The decomposed plants will help fertilize the plants or seeds planted later.

Typically a combination of methods is used in organic situations

*i. Manually pulling weeds*

Labourers are used to pull weeds at various points in the growing process

**Figure 4: Manually pulling weeds**

*ii. Boiling water*

Pour boiling water to weed, they will become more green and then die in few hours. Best for weed in cracks or other hard to reach locations.

*iii. Vinegar*

Vinegar kills the visible part of the weed. They will wrinkle and die next day, although the root will still be in place to continue growing.

*iv. Mechanically tilling around plants*

Tractors are used to carefully till weeds around the crop plants at various points in the growing process. Besides tilling, other mechanical weed control methods also exist.

**Figure 5: Mechanically tilling around plants**

*v. Ploughing*

Ploughing includes tilling of soil, intercultural ploughing and summer ploughing. Ploughing through tilling of soil uproots the weeds which causes them to die. In summer ploughing is done during deep summers. Summer ploughing also helps in killing pests.

**Figure 6: Ploughing**

*vi. Crop rotation*

Rotating crops with ones that kill weeds by choking them out, such as hemp, Mucuna pruriens, and other crops, can be a very effective method of weed control. It is a way to avoid the use of herbicides, and to gain the benefits of crop rotation.

*vii. Weed mat*

A weed mat is an artificial mulch, fibrous cloth material, bark or newspaper laid on top of the soil preventing weeds from growing to the surface.

**III. METHODOLOGY**

*A. Introduction*

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 labour carrying backpack type sprayer which requires more human effort. The weeding is generally done with the help of Bulls which becomes costly for farmers having small farming land. So to overcome these above two problems, we tried to eliminate these problems and designed the equipment which will be beneficial to the farmer for the spraying and weeding operations.

*B. Objectives*

• 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).

• Making such a machine which can be able to perform both the operation (spraying and weeding).

So considering these points related to spraying and 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.

*C. Brief Description of Drawing*

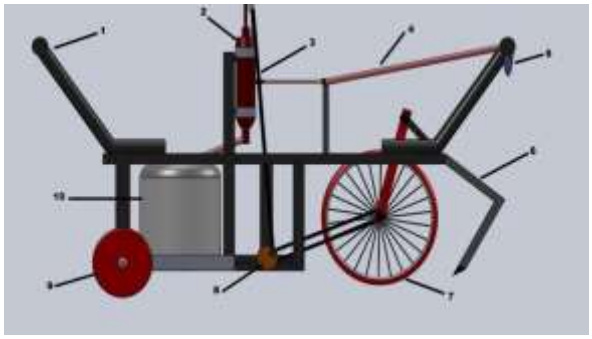

**Figure 7: Front view of CAD model**

1- Handle for controlling. 6 - Weed cutter plate.

2- Reciprocating pump. 7 - Wheel.

3- Connecting link (bar). 8 - Crank.

4- Flexible pipes. 9 - Supporting wheels.

5- Nozzles. 10 - Storage tank.

The machine shown in figure 7 is designed to perform the two operations namely “Spraying and weeding”. For Spraying pesticides, the reservoir tank contains pesticides is attached to the reciprocating pump. The outlet of the pump is connected to the spraying nozzle through flexible pipe. A cutting plate is attached just below the reservoir tank for the weeding purpose.

*D. 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.

*E. Detailed Description*

It consists of the following parts

1. *Handle for controlling*
2. *Reciprocating pump*

These types of pump operate by using a reciprocating piston. The liquid enters a pumping chamber via an inlet valve and is pushed out via an outlet valve by the action of the piston or diaphragm. Reciprocating pumps are generally very efficient and are suitable for very high heads at low flows. This type of pump is self-priming as it can draw liquid from a level below the suction flange even if the suction pipe is not evacuated. The pump delivers reliable discharge flows and is often used for metering duties delivering accurate quantities of fluid.

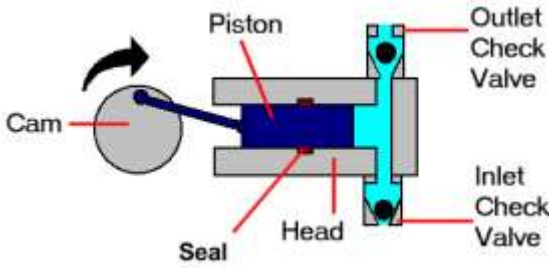


**Figure 3. 5. 2: Reciprocating pump**

*3. Connecting link*

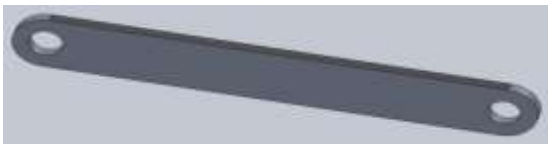

**Figure 3.5.3:** Connecting link

*4. Nozzles*

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

- Regulate flow.
- Atomize the mixture into droplets.
- Disperse the spray in a desirable pattern.

The hydraulic spray nozzle used in the application of pesticides has several functions. One of its main purposes is to convert the spray solution into droplets for efficient target coverage. The target may be foliage, bark, stumps, soil or insects. In association with other variables, e.g. height above target, travelling speed, operating pressure, the nozzle also has a role in spray pattern delivery, volume rate delivered and sprays quality produced. Various nozzle types are required to accomplish these roles within a range of operating variables.

Nozzles are generally best suited for certain purposes and less desirable for others. In general, herbicides are most effective when applied as droplets of approximately 250 microns; fungicides are most effective at 100 to 150 microns, and insecticides at about 100 microns. Nozzles determine the rate of pesticide distribution at a particular pressure, forward Speed and nozzle spacing. Drift can be minimized by selecting nozzles that produce the largest droplet size while providing adequate coverage at the intended application rate and pressure. Nozzles are made from several types of materials.

The most common are brass, plastic, nylon, stainless steel, hardened stainless steel, and ceramic. Brass nozzles are the least expensive but are soft and wear rapidly. Nylon nozzles resist corrosion, but some chemicals cause thermoplastic to swell. Nozzles made from harder metals usually cost more but will usually wear longer.

**Figure 3.5.4:** Nozzle

*5. Weed cutter plate*

Weeding is the process of eliminating the competition of unwanted plants to the regular crops so that crops can be grown profitably. Management of weeds is an important component of production techniques as elimination of weeds is expensive and hard to achieve. Weeds are uprooted by the teeth of the weeder and buried in the mud by push and pull operations of the weeder.

*6. 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 labour in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel.

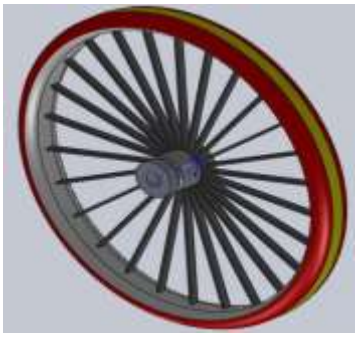

**Figure 8: Wheel**

Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by the application of another external force or torque.

*7. Crank*

A crank is an arm attached at right angles to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion into reciprocating motion, or vice-versa. The arm may be a bent portion of the shaft, or a separate arm attached to it. Attached to the end of the crank by a pivot is a rod, usually called a connecting rod. The end of the rod attached to the crank moves in a circular motion, while the other end is usually constrained to move in a linear sliding motion.

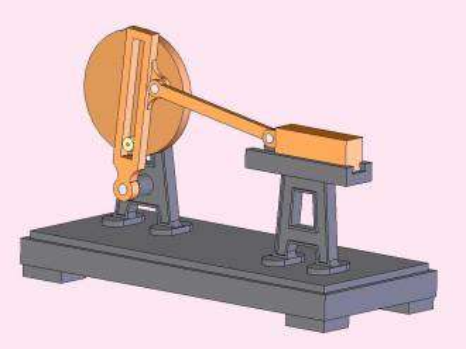

**Figure 9: Crank (mechanism)**

The term often refers to a human-powered crank which is used to manually turn an axle, as in a bicycle crank set or a brace and bit drill. In this case a person's arm or leg serves as the connecting rod, applying reciprocating force to the crank. There is usually a bar perpendicular to the other end of the arm, often with a freely rotatable handle or pedal attached.

*8. Chain drives*

The chains are used to transmit power from one shaft to another by means of sprocket wheel which rotate at the same speed or different speeds.

*9. Centrifugal pump*

Centrifugal pumps are a sub-class of dynamic axis symmetric work-absorbing turbo machinery. Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. In the typical case, the fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a

diffuser or volute chamber (casing), from where it exits. Common uses include water, sewage, petroleum and petrochemical pumping. The reverse function of the centrifugal pump is a water turbine converting potential energy of water pressure into mechanical rotational energy.

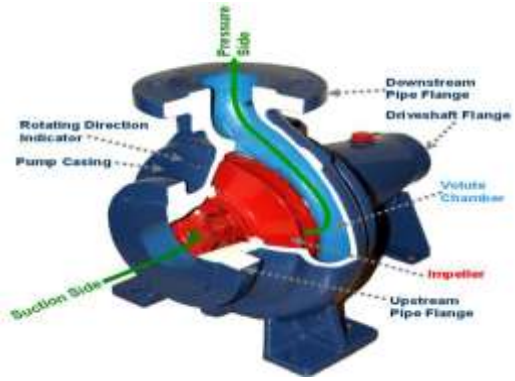


**Figure 10: Centrifugal Pump**

**VI. TESTING OF MACHINE**

The machine is tested on the farming land and got the satisfactory results and then it is compared with traditional method.

The results are as shown below

For 1 acre of land = 75 litre of water + 250 ml of pesticide

Cost of 1 litre pesticide = Rs 7000/-

For 250 ml of pesticide = Rs 1750/-

Cost of labour per day = Rs 200/-

**Table 2 Testing Results**

| By traditional method | By Machine |
|---|---|
| **Labour cost = Rs 400/day** | Labour cost = Rs 200/day |
| **Cost of Pump** | Discharge through sprayer = 1 lit/min |
| **=Rs.3000 – 4000** | A labour can spray 6 acre of land in one day |

| A labour can spray 3 acre of land in one day | |
|---|---|
| **For 3 acre of land** | For 6 acre of land |
| **=3*1750+400** | =6*cost of pesticide+labour cost |
| **=Rs. 5650** | =6*1750+200 |
| **For 6 acres = 2*5650** | =Rs10700. |
| **= Rs. 11300** | |

As shown in result, it reduces the labour cost by resolving the two days work in a single day. So the proposed machine not only saves the money but also the time. The proposed machine takes Rs. 10700/- for spraying 1 acre of land in one day whereas traditional method takes Rs. 11300/- in two day.

## VII. 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 so that he can afford it. 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.

**Fig. 11 CAD model of agricultural pesticide sprayer**

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