

# Design and Fabrication of Manually Operated Weeder with Pesticides Sprayer

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**Abstract** - India is a largest populated country, which contains 65% population depending on agriculture. Generally Indian farmer use to traditional way that is spray carry on backpack and weeding is done by bulls. Which become times consuming and costly this both problems over come by using multi nozzle pesticides sprayer and weeder machine. For better yield of crop multi nozzle spraying and simultaneous weeding is must this papers attends to design such a flexible sprayer and weeder. This work gives continuously flow of liquid at required pressure, height and gives freedom of easy engaging and disengaging weeder. This paper suggest a model of manually operated multi nozzle spryer with weeder according to crop which will gives optimum results in less time. Pushing mechanism required less effort and three wheel mechanisms gives proper balancing of machine.

**Key words**- flexible weeder, multi nozzle sprayer, time, cost.

## 1.INTRODUCTION

India is an agricultural based country most of the population is depending on farming. India has a problem of high population and low level of land productivity, low level of farm mechanization, insufficient power availability as compared to the developed nations. Even average land holders in Japan uses proper mechanization for agricultural which led to great achievement for increasing crop productivity. But in India for small farmer's mechanization is difficult even though steps were taken to increase availability of power operated machines, combine harvesters, power tillers, irrigation pumps, solar pumps, dripping system etc.

In Agricultural sector use of cheap and beneficial equipment for effective weeding and spraying for increase productivity which is very important for better contribution for India's GDP.

The principles of motion of trolley which transmit its rotary motion from chain and sprocket arrangement and reciprocating piston into the cylinder for pumping the pesticides which is used to the manually operated organic fertilizers cum pesticides sprayer[1].

Generally used low cost Knapsack sprayer having major drawbacks as back pain and exertion of the user due to its heavy Weight and manual pumping. Manually operated pumping are not constant they generate uneven pressure

inside the spray cylinder. When Pressure in the tank fluctuates, it causes flow to become turbulent which is highly undesirable. When the pressure inside the cylinder increases, the width of spray increases, therefore causing the wastage of pesticides. In I C engine sprayer (Power Sprayers) uses an engine instead of manual operation.

The drawbacks include-The I C engine cause high vibrations, noise this could result in number of health problems. Due to heavy weight back pain causes. The tractor mounted sprayers are very expensive, not useful for small space and all type of crop. It suitable for heighted crop in large amount.[5]

## 1.1 Spraying methods:

Different types of spraying methods are:

### 1) Hydraulic Sprayer:

It contains hydraulic nozzle it was mixed water and pesticide sprayed with atomize form. It is old technology still this used by most of farmers .

### 2) Knapsack (Backpack) Sprayer:

Operating principle of this is hand operated lever create a pressure difference in which pesticides and liquid is forced through nozzle in fine droplet form. The pressure of this sprayer approximately 7kg/sq cm. and capacity of storage tank is less than 20 liters. the components of backpack sprayer are lever, pump, tank, lance, boom and nozzle. This sprayer mainly cause back pain and fatigue to labor.

### 3) Motorized Mist Blowers:

This motorized mist blower is designed and developed for spraying the pesticides on tall trees like cocoa capsids. This is also used to improve horizontal spray and penetration into crops. The kioritz DM9 is being used to apply a fungicide against rice sheath blight in Vietnam.

### 4) Tractor mounted equipment ( Lite-Trac):

The Lite-Trac name comes from "lite tractor", due to the patented chassis design, facilitating the leaving machines manufactured by company to have lite footprint for mineral soil compression. This is Europe's largest lite tractor Manufacturer Company. Large storage and high spraying

capacity but high cost so small scale Indian farmers cannot afford this.

#### 5) CDA/ULV Application Equipment:

CDA means controlled droplet application and ULV means ultra low volume. Rotary nozzles are normally used to achieve to CDA. The reliable way of applying pesticides at ULV rate of application. This is hand-held cheap equipment and reliable.[1]

Weed is a plant that competes with crops for water, light, and nutrients. This can reduce crop production and decrease the value of land, increase cost of cleaning. So weeding is essential. Weeding is the removal of unwanted plants in the field. It is the most difficult tasks in agriculture. Traditional weeding process is costly and time consuming. Manual weeding process is hard working. Mechanical weeding is effective safe and small size it minimizes hard work and keeps the soil surface loose ensuring soil aeration. These mechanisms contribute significantly to safe food production.[3]

### 1.2 Weeding methods:

#### 1) Weed mat:

For preventing weeds from growing to the surface fibrous cloth material, bark or newspaper laid on top of the soil is a weed mat also called artificial mulch. Mulching may broadly be categorized into live mulch and dead mulch. Mulching is best-suited to wide-row field crops, e.g. cotton, sugarcane, maize, fruit crops, e.g. citrus, banana, grape and plantation crops, e.g. tea, coffee, rubber etc.[4]

#### 2) Boiling water:

If we pour boiling water at base of weed, they will rapidly change to green and then die in few hours. It is best suited for weed in cracks or hard to reach locations.

#### 3) Ploughing:

Tilling of soil, inter-cultural and summer ploughing all comes under ploughing. Tilling of soil means uproots of weeds which causes them to die. Ploughing is done during deep summers helps in killing pests.

#### 4) Crop rotation:

Crop rotation with such that kill weeds by choking them out as hemp, *Mucuna pruriens*, etc can be a very effective method of weed control. So there will be no use of herbicides, and will gain the benefits of crop rotation [2]

#### 5) Soil solarization:

The basic principle behind soil solarization is that light received from the sun is in the form of electromagnetic short waves, which easily pass through the transparent colorless polyethylene films and reach to soil. As a result,

soil is heated up and emits long-wave terrestrial radiation, A decrease in the heat loss of soil through evaporation and convection is the main cause of increase in soil temperature by transparent polyethylene films.

#### 6) Mechanically tilling around plants:

Tillage is the manipulation of soil with tools and implements for loosening the surface crust and bringing about conditions favorable for the germination of seeds and growth of crops. The main objectives of tillage are to provide a good seed bed and a root bed for smooth germination and better root growth and subsequent rapid seedling establishment and to reduce/control initial flushes of weeds by means of exhausting weed seed bank. It also reduces population of perennial weeds by exhausting food reserves of the vegetative structures

#### 7) Manually pulling weeds:

Manual weeding effectively controls annual weeds having erect and upright growth, while weeds growing prostrate, rosette and horizontal get frequently cut /soil surface on pulling by hands and may rejuvenate/regenerate from tap roots left inside the soil [4]

### 2. METHODOLOGY:

Indian farmers use traditional method, there is large scope for development in agricultural sector.

In traditional method weeding process are done by the bull which become costly for farmers having small farming land its time consuming and requires separate setup.

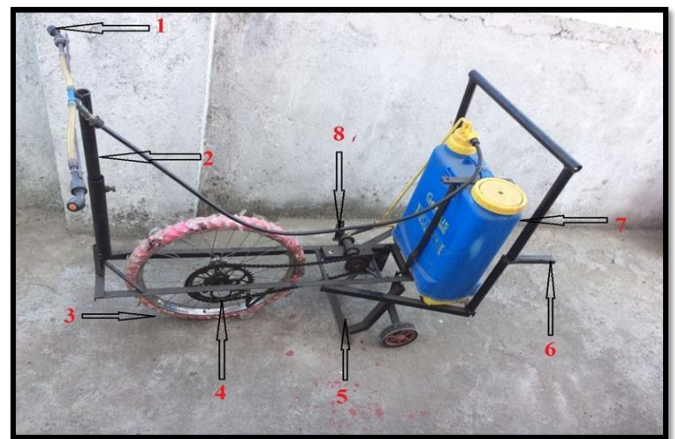
The spraying is traditionally done by backpack sprayer with labor which requires more human effort, it cover small area, time consuming and low storage capacity. Therefore to overcome above problems, we have design and develop the flexible equipment which will be beneficial to the medium and small scale farmer for the weeding and spraying operations.

Objectives-

- 1) Decrease the cost of weeding and spraying machine.
- 2) Save the machining time, labor cost, and operational cost.
- 3) Making such a machine can perform weeding and spraying simultaneously and flexibly (required operation on/ off).
- 4) Work reliably under different working conditions efficiently.
- 5) Machine can be used to operate small farming land.

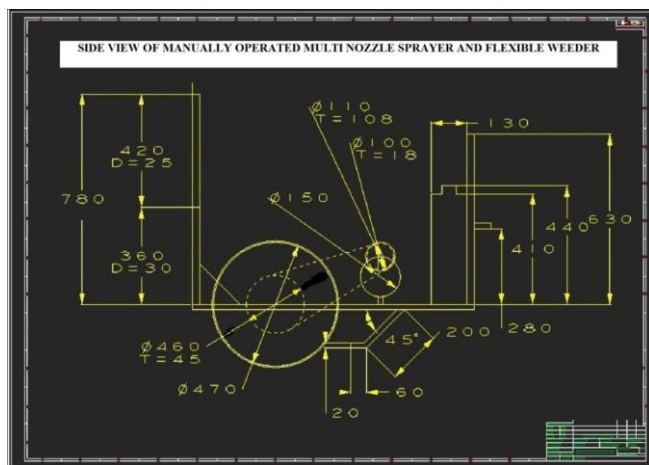
**Table1.** Horizontal Distance between plant and Height of crop [6]

Sr no.	Name of crop	Horizontal Distance between plant(ft)	Height of crop(ft)
1	Groundnut	1.25	1.5
2	Pearl millet	1.25	5.5-7
3	Sorghum	1.25	5.5-7
4	Sugar cane	1.25	5.5-7
5	Cotton	2-3	2-5
6	Soya bean	1.25	5.5-7
7	Pigeon pea	1.25	3-4
8	Corn	1.25	5-7



**Fig.2:** Image of manually operated multi nozzle sprayer and flexible weeder

**Design of experimental model.**



**Fig.1:** side view of manually operated multi nozzle sprayer and flexible weeder

**Table 2.**Nomenclature

Sr.no.	Name
1	Nozzle
2	Adjustable bar
3	Wheel
4	Chain sprocket
5	Weeder
6	Handle
7	Tank
8	Mechanism

**Table 3.** Selection of components

Sr. no.	Process	Time (min)	Area (sq.ft)
1	Knapsack sprayer	4.8	900
2	Manual multi sprayer	2.53	900
3	Manual Weeding	17.6	900
4	Manually Multi sprayer and weeder	9.2	900

### 3. Design calculations:

Sprocket-No.of teeth = $T_1=42$  diameter ( $D_1$ ) =7cm

Free wheel- No.of teeth = $T_2=18$  diameter ( $D_2$ ) =4cm

$$\text{No. of strokes (pump)} = \frac{\text{No.of teeth of sprocket}}{\text{No.of teeth of free wheel}} = \frac{T_1}{T_2} = \frac{42}{18} = 2.33$$

Sprocket ( $D_1$ ) is mounted on wheel therefore wheel rotation equal to sprocket rotation.

Diameter of wheel = 44.5 cm, Radius ( $r$ ) = 22.25cm

$$\text{Wheel periphery} = 2\pi r = 2 * 3.14 * 22.25 = 139.8 \text{ cm} = 4.58 \text{ ft}$$

Sr. no.	Process	Time(hour)	Cost(Rs)
1	Knapsack sprayer	1.93	116
2	Manual multi sprayer	1.63	98
3	Manual Weeding	7.09	184
4	Manually Multi sprayer and weeder	3.71	126

Distance covered by one rotation of wheel = 4.58 ft  
Time require

d for one rotation of wheel = 3 sec

$$\text{Time required for 1 ft distance} = \frac{4.58}{3} = 1.52 \text{ sec}$$

Time required for 100 ft distance = 152 sec (2.53min)

No. of nozzles = 3

Pressure = 1 to 3 bar (14.5-43.5 psi)

Area covered by each nozzle approximate 1.5 m<sup>2</sup>

Calculation for weeder.

Weeder blade length = 32 cm and width = 2 cm

If weeder covered 5cm length of land

Total area covered by weeder is 32\*5 = 64 cm<sup>2</sup>

**Table 3** data collection from different process Consider 300 Rs per day labor cost and time 5 hours working in one day.

**Table 4** Cost and time required for one acre

Sr.no.	Name of component	Dimensions	Material used
1	Frame	120*46*60	MS
2	Tank		Plastic
3	Nozzle	70 mm	Plastic
4	Adjustable bar	50cm	MS
5	Nozzle bar	52 cm	MS
6	Link	18 cm	MS
7	Front wheel	Dia=43	Steel
8	Rear wheel	Dia=12	Plastic
9	Sprocket	T=42, dia=7	Steel
10	Free wheel	T=18 dia=4	Steel
11	Shaft		MS
12	Weeder blade length	32 cm	MS
13	Weeder frame	24 cm	MS

### 4. CONCLUSION:

- 1) It is upgraded design of manually operated weeder and sprayer which will be helpful for small land farmers. It consumes less time and saves money as compared with conventional spraying and weeding.
- 2) It covers twice area of spraying than manually spraying. Moist soil weeder efficiency increases due to proper penetrating and dig out of soil.
- 3) It does spraying and weeding simultaneously and that of conventional does separately. So this requires less time.
- 4) This machine does not require any fuel or power so maintenance is less. This model removes problem of back pain. As per our requirement we can separately use weeder or sprayer.

### REFERENCE:

- 1) Kamlesh Kishor Rangari, Swapnil B. Bandane, Pravin Jaybhaye, Dr. S.K. Choudhary, Prof. R.D. (2015) "Design and fabrication of organic fertilizer and pesticides sprayers". International Journal for Scientific Research & Development| Vol. 3, Issue 01, 2015 | ISSN (online): 2321-0613.
- 2) Laukik p. Raut , Smit B. Jaiswal, Nitin Y. Mohite (2013) "design,development and fabrication of agricultural

**pesticides sprayer with weeder**". (IJARS) ISSN: 2278-9480 Volume 2, Issue 11 (Nov - 2013).

- 3) HP Pathade, Priya Shinde, Nilesh Magar, Sainath Mundaware (2015) "**Multipurpose weeding machine**".(ijmrd) Vol :2, Issue :4, 402-405 April 2015 ISSN: 2349-4182
- 4) T.K. Das, Ramanjit Kaur, Rishi Raj, Kapila Shekhawat, Raj Singh and Anil K. Choudhary. "**Weed management in pigeonpea-based cropping systems**" Indian Journal of Weed Science 47(3): 267–276, 2015.
- 5) Sayali Salkade, Varun salian ,Gaurav sakalgaonkar, Aashna Pawar (2014) "**Design Considerations of a Cycle Mounted Agricultural Sprayer.**" International Journal of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181 IJERTV3IS110566 Vol. 3 Issue 11, November-2014.
- 6) Sandeep H. Poratkar, Dhanraj R. Raut(2013) "**development of multinozzle pesticides sprayer pump**". "International journal of Modern Engineering Research", ISSN: 2249-6645, volume 3, Issue 2, pp-864-868, (April-2013).
- 7) Sridhar.H.S (2013) "**development of single wheel multi use manually operated weed remover**". International Journal of Modern Engineering Research Vol. 3, Issue. 6, Nov - Dec. 2013 pp-3836-3840 ISSN: 2249-6645