



## DEVELOPMENT AND EVALUATION OF MANUALLY OPERATED WHEELBARROW SPRAYER

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**Abstract:** Spraying is the necessary process for controlling the pests and diseases grown on field crops. For that purpose, many types of hand operated and shoulder mounted sprayers used in the world. But due to less field capacity and low application rate, those are not suitable for large land and the maximum discomfort was experienced in the left clavicle region followed by lower back, neck, left thigh and right clavicle of operator. It also required high labour requirement. Keeping these points in view the manually operated wheelbarrow sprayer developed with several parts such as frame, power transmitting unit which includes ground wheel, chain and, power transmission shaft, crank wheel, connecting rod, knapsack spraying tanks, cut-off valve, distribution tubes, nozzles and rear wheels for support and evaluated performance on both plain land and ridge and furrow land. The spraying rate was observed 152.63.lit/hr on plain land and 130.72lit/hr on ridge and furrow land. The actual area covered for plain land was 1.45 ha/hr and 0.66 ha/hr for ridge and furrow land. The application rate of liquid was observed about 105.52 lit/ha for spraying on plain land and 106.78 lit/ha for ridge and furrow land. The time requirement (man hour) was observed 0.69 hr/ha on plain land and 1.51 hr/ha on ridge and furrow land.

**Key Words:** Wheelbarrow, Spraying Rate, application rate, Man Hour Requirement.

### Introduction:

India is said to be an agricultural base country directly or indirectly 75% of the peoples are dependent on farming, in this agriculture sector there is a lot of field work, such as weeding, reaping, sowing etc. Apart from these operations, spraying is necessary operation for controlling weeds by spraying herbicide, for controlling insects by spraying insecticide, for control of fungus diseases by spraying fungicide and also used to spray micro nutrients on crop for more production. Lever-operated knapsack (LOK) sprayers are manually operated pest control equipment widely used by Indian farmers. Out of a total of 15 million sprayers in the country, about 70% are of this type. (Ghaghara et al. 1991). The maximum discomfort was experienced in the left clavicle region followed by lower back, neck, left thigh and right clavicle. The postural discomfort data indicated a need for better mounting of the knapsack sprayer.

The many small fields are sprayed by shoulder mounted sprayers but these sprayers are not suitable for large areas and different cropping patterns because, spraying of agrochemicals in the field is a tedious and laborious task. The small farmers cannot afford to buy the power operated sprayer or tractor-mounted sprayers available in the market, as these are very costly and are of not much use to small farmers due to small land holdings.

Hence the manually operated wheelbarrow sprayer was developed and evaluated the performance by properly adjustable boom height, nozzle spacing, proper spraying rate, uniform nozzle discharge, reducing the comparable time of operation and reduce operator drudgery.

### Materials and methods

The developed manually operated Wheelbarrow sprayer consist of frame, ground wheel and rear wheel, knapsack spraying tank, distribution tubes and overflow relief valve, shaft, sprockets, chains and bearings, nozzles, extension boom pipes.

The detailed specifications of each part of the developed wheelbarrow sprayer are given in Table No.1.

**Working of wheelbarrow sprayer**

Whenever operator push this sprayer, ground wheel start rotating which transmit the rotating power to the sprocket of crank shaft with help of chain and sprocket arrangement. The connecting rod is connected to transmitting this rotating motion of

crank shaft through crank wheel to reciprocating motion of both tank piston and sprayer start spraying. The cut-off valve is provided for controlling the flow of liquid from distribution tubes towards the nozzle. The overflow valve is provided for releasing the excessive pressure generated during spraying operation which is fixed at top of the tank. Thus required quantity of liquid is sprayed by uniform nozzle.

**Table 1: Specification of developed manually wheelbarrow sprayer**

Sr. No.	Particulars	Dimensions
1.	Overall Dimensions(l x w x h), (mm)	1670 x 295 x 935
<b>A) Frame</b>		
1.	Width ,(mm)	1480
2.	Frame height, (mm)	685
<b>B) Ground wheel and Turning wheel</b>		
1.	Ground wheel diameter,(mm)	600
2.	Turning wheel diameter, (mm)	250
3.	Ground wheel width,(mm)	200
<b>C) Knapsack spraying tank</b>		
1.	No. of tank	2
2.	Tank capacity each,(litre)	16
3.	Overall dimensions of each tank(l x w x h),(mm)	350 x 140 x 460
<b>D) Distribution tubes and Overflow relief valve</b>		
1.	Diameter of tube,(mm)	12
2.	No. of relief valve on each tank	1
3.	No. of cut-off valve for each tank	1
<b>E) Power transmission unit</b>		
1.	No. of large sprocket	1
2.	No. of small sprocket	3
3.	No. of teeth on small sprocket	18
4.	No. of teeth on large sprocket	44
5.	Velocity ratio	1:1 and 1:2.5
6.	Piston wheel diameter, (mm)	140
7.	Length of connecting rod,(mm)	175
8..	Distance between ground wheel sprocket and driven sprocket, (mm)	900
9.	Distance between large sprocket and small sprocket, (mm)	465
10.	Distance between two sprockets on driven shaft,(mm)	180
11.	Chain A length, (mm)	2000
12.	Chain B length, (mm)	1380
<b>F) Nozzles</b>		
1.	No. of nozzles	4
2.	Type of nozzle	Flat Fan Type
3.	Discharge of single nozzle(ml/min)	600-650
4.	Nozzle spacing	Adjustable

G) Extension boom pipes		
1.	Total boom height from ground,(mm)	930
2.	Vertically adjusted height of boom from ground,(mm)	340 - 880
3.	Horizontally length of boom pipe	Adjustable
4.	Distance between two vertical boom pipes,(mm)	292
5.	Total boom width,(mm)	3892

**Performance evaluation of the manually operated wheelbarrow sprayer**

The manually operated wheelbarrow sprayer was evaluated for its performance on the field of Dr. D. Y. Patil College of Agricultural Engineering and Technology. The test was carried out both plain land (T<sub>1</sub>) and ridge and furrow land (T<sub>2</sub>). The number of parameters observed during performance were spraying rate (lit/hr), Area covered (ha/hr), Application rate (lit/ha) and man-hr requirement (man-hr/ha) for both land. The wheel barrow sprayer was evaluated on both plain land (T<sub>1</sub>) and ridge and furrow land (T<sub>2</sub>) at 30.24 % and 32.35 % moisture content of the soil respectively.

**Results and discussion**

The tests were conducted for manually operated wheelbarrow sprayer both on plain land

(T<sub>1</sub>) and ridge and furrow land (T<sub>2</sub>). The field condition and performance is given in Table no. 2 and Table no.3 respectively.

The average effective field capacity and field efficiency of developed manually operated wheelbarrow sprayer were observed as 1.45 ha/hr and 83.94% in plain field and 0.66 ha/hr and 81.49% ridge and furrow field respectively.

The average operating speed of developed manually operated wheelbarrow sprayer was observed as 2.87 Km/hr and 2.50 Km/hr in plain field and ridge and furrow field respectively.

The average time required (man-hour) for spraying was observed 0.69 hr/ha and 1.51 hr/ha in plain field and ridge and furrow field respectively. The application rate of spraying was found as 105.52 lit/ha and 106.78 lit/ha in both field respectively.

**Table No 2. Field condition for**

Sr. No.	Particulars	Treatments	
		T <sub>1</sub>	T <sub>2</sub>
1	Kind of field	Plain, fine textured	Ridge & furrow, fine textured
2	Length, m	50	50
3	Width, m	6	3.24
4	Area, m <sup>2</sup>	300	162
5	Type and character of soil	Laterite	Laterite
6	Soil moisture,%	30.24	32.35
7	Labour charge, Rs/day	250	250

**Table 3 Performance of manually operated wheelbarrow sprayer**

Sr. No.	Parameters	Treatments	
		T <sub>1</sub>	T <sub>2</sub>
1	Effective field capacity, ha/hr	1.45	0.66
2	Theoretical field capacity, ha/hr	1.72	0.81
3	Field efficiency, %	83.95	81.49
4	Discharge, lit/hr	152.63	130.72
5	Application Rate, lit/ha	105.52	106.78
6	Operating Speed. Km/hr	2.87	2.50
7	Time required, hr/ha	0.69	1.51

8	Swath Width, m	6.0	3.24
9	Operating cost, Rs/ha	28.31	62.26

### Cost of operation

The cost of operation of developed manually operated wheelbarrow sprayer was calculated on the basis of machine cost 8000 Rs, effective field

capacity and labour charges 250Rs/day. It was observed as 28.31 Rs/ha and 62.26 Rs/hr in plain field and ridge and furrow field respectively.



**Fig.1: Manually Operated Wheelbarrow Sprayer**

### Conclusions

The study revealed that, The average effective field capacity and field efficiency of developed manually operated wheelbarrow sprayer were observed as 1.45 ha/hr and 83.94% in plain field which was more than the ridge and furrow. The application rate of spraying was found as 105.52 lit/ha and 106.78 lit/ha in both field respectively. The

cost of operation of developed manually operated wheelbarrow sprayer was observed as 28.31 Rs/ha and 62.26 Rs/hr in plain field and ridge and furrow field respectively. The manually operated manually operated wheelbarrow sprayer was found very effective in the plain land as compare with ridge and furrow land.

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