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Research Article

DEVELOPMENT AND PERFORMANCE EVALUATION OF CYCLE MOUNTED BATTERY-OPERATED BOOM SPRAYER

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Abstract: The Cycle mounted battery operated boom sprayer technology is most suitable for energy alternate device for power sprayers. These sources of energy are clean, risk free and constitute no harm to man and environment. The initial investment and operational cost of Cycle mounted battery operated boom sprayer was found to be less compare to the existing power sprayer in the market. It was observed that spray distribution was uniform throughout the field. The sprayer worked satisfactorily under field conditions. It can also be used for vegetables, row crops and orchard crops to spray chemicals or bio-pesticides or herbicides. The developed sprayer was reducing labour drudgery, time and very much suitable for marginal and small farmers. This sprayer was user and eco-friendly. The area coverage of the developed boom sprayer was 0.61 ha h-1 and the field efficiency was 83.56 %. The production cost of the Boom sprayer was Rs 5,650.0 and the cost of operation was Rs 92.0/hr.

Keywords: *Cycle mounted, Boom Sprayer, Nozzle and Actual field capacity*

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Introduction

Indian agriculture is undergoing a gradual shift from dependence on human power and draft animal power to mechanical power because maintenance of draft animal power and manual labour is becoming increasingly costly. Hence mechanical power has become more economical and indispensable to meet targets of timeliness and efficient utilization of natural resources and input use [1]. By the year 2050 even the most conservative estimates predict that the world's energy requirements will more than double. Energy is a prerequisite to economic stability and its supply at an affordable cost for the both the developed and developing world cannot be guaranteed. Pests, insects and diseases are disastrous to the crops since origin of agriculture. Different methods are used to control these pests and insects but most effective and reliable method to control these is chemical application. In recent decades increased use of chemicals caused hazardous condition related to environment and public health. Nowadays agriculture is facing significant challenges, due to increase in public concerns about the impacts of agricultural production practices on the environment to have a safe and secure environment for living. So, agricultural community is forced to invest huge amount of money in the area of controlled chemical applications. Due to daily rising demand of human population, decreasing crop acreage, use of pesticide in agriculture is increasing day by day. Excessive use of chemicals results in the resistivity of the insects to the chemicals, pollutes the environment and ground water and also results in increase in the cost of crop production.

In India, most of the farmers uses manually operated sprayer such as knapsack sprayer. But these sprayers are inefficient, time consuming and exhausting. Using such type of sprayer operator comes in direct connect with toxic insecticides leading to health issues. In comparison to knapsack sprayer, tractor operated sprayers are more efficient. These sprayers can be operated at higher pressures and at desired forward speeds. Sahay (2008) [2] observed that with increase in pressure from 2 bars to 4 bars, average droplet density increased by 50% and higher pressure produced smaller size droplets with better uniformity of spray distribution. Pimental (1995) [3] reported that less than 0.1% of pesticides applied for pest control reach their target pests. Thus, more than 99.9% of pesticides used move into the environment where they adversely affect public health and beneficial biota, and contaminate soil, water, and the atmosphere of the ecosystem. Improved pesticide application technologies can improve pesticide use efficiency and protect public health and the environment. Shukla, *et al.,* (1987) [4] developed a tractor mounted air-assisted sprayer and compared with a convention tractor mounted boom sprayer in cotton crop. Both the sprayers were operated at the forward speed of 4 km/h and working pressure of 3.5 kg/cm^2. The droplet deposition on the underside of the leaves of top, middle and lower portion of plants in case of conventional sprayer was negligible but in case of air-assisted sprayer deposition were 43, 23 and 14 drops/cm^2 area on underside of top, middle and bottom leaves respectively.

Very little attention has been given for the development of cheaper and improved sources of energy operated farm mechanization technologies. Therefore, the experiment was undertaken to study and develop the Cycle Mounted Battery-Operated Boom Sprayer at GPS Institute of Agricultural management, Bangalore.

Materials and Methods

A battery-operated boom sprayer is to be interconnected with a tank for atomizing various liquids. The sprayer is manufactured from bicycle wheel connected to the battery sprayer with a set of nozzles. The sprayer is manufactured from a relatively few numbers of mechanical parts at a correspondingly reduced cost and, therefore, can be more easily and quickly assembled when compared with conventional pump sprayers. More particularly, the pump sprayer of this invention comprises a cycle wheel, chain drive and battery having a hollow pressure chamber connected to a liquid tank and having a suction tube extending there from into the tank. A manual actuating reciprocating force is successively applied to cause the poppet (piston) to move down stroke and up stroke in the cylinder through the valve body.

Accordingly, the spring is compressed and the seal between the valve body and the valve housing is opened to establish an air path there between and permit air from the atmosphere to enter the tank. Moreover, during the down stroke, the suction tube which extends into the tank is sealed by the valve body so that by the end of the down stroke, air within the pressure chamber of the poppet is fully compressed and the compressed air from the pressure chamber of the poppet is blown through the suction tube and into the tank. As the poppet moves the fluid from the tank is drawn by suction into the pressure chamber via the suction tube. The fluid drawn into the pressure chamber is atomized and sprayed from the spray orifice of the spray head during a subsequent stroke. The overall view of the cycle mounted battery-operated boom sprayer is as shown in [Fig-1]. The specifications of the boom sprayer are as per [Table-1]. The Test procedures envisaged in "RNAM Test Codes and Procedures for Farm Machinery" for spraying was utilized.

Fig-1 Developed Cycle Mounted Battery-Operated Boom Sprayer

The sprayer was developed in such way that, the height of Boom from ground and nozzle spacing can be adjusted as per the crop. The nozzles can be rotated in 3600 based on the need. The boom can also be adjusted to spray from top of the crop and side of the crop. The sprayer can be used in vegetables, field crop and orchard crop.

Table-1 *Specifications of Cycle mounted battery-operated boom sprayer*

SN	Components	Data
1	Liquid tank capacity	20 liters
2	Length of Boom	2.28 m
3	Height of boom	Adjustable up to 1. m
4	Type of Nozzle	Flat Pan
5	Numbers of Nozzles	04
6	Diameter of wheel	0.30 m
7	Pump	Diaphragm type
8	Pump Pressure	180 to 200 PSI
9	Battery Capacity	12 Volts 12 Ah
10	Overall Dimension	Length- 1.52m, Width-2.28m and Height-1.21m

Fig-2 Field view of developed sprayer in Chilly crop

Performance evaluation of Cycle mounted Battery-Operated Boom Sprayer

Field experiments were carried out at GPS Institute of Agricultural Management Farm, Gorinabele, Nelamangala, Bangalore Rural and farmers field during the period of December 2019 to February 2020, to study the performance evaluation of Cycle mounted battery-operated boom sprayer over existing power sprayers used are shown in [Fig-1]. RNAM Test Codes and test Procedures for Farm Machinery were envisaged to evaluate the field performance of Cycle mounted battery-operated boom sprayer. The Boom Sprayer was demonstrated in Chilly, Onion, Tomato and Capsicum crops [Fig-2 to Fig-5].

Fig-3 Field demonstration of boom developed sprayer in Tomato crop

Fig-4 Field demonstration of boom developed sprayer in Capsicum crop

Fig-5 Field demonstration of boom developed sprayer in onion crop

The developed sprayer was tested for chilly crop at GPS institute of Agricultural management experimental farm at Gorinabele, Nelamangala [Fig-2], the crop spacing of chilly crop was 0.60×0.45 m (row × plant), height of crop was observed as 0.55 to 0.84 m with average value 0.69 m. The nozzle discharge was 51.1 liter per hour. The width of spray coverage was 2.91 m and speed of operation was 2.52 km h^{-1}.

Theoretical field capacity

Theoretical field capacity was calculated by following formula [2]. This area coverage did not considered the time loss due to turning, tank filling and other loss.

Theoretical field capacity (ha h^{-1}) = Width (m) x Speed (km/hr)/ 10

The theoretical area covered by boom sprayer was 0.73 ha h^{-1} observed.

Table-2 *Performance evaluation of Cycle mounted battery operated boom sprayer*

SN	Parameters	Reading observed
1	Crop	Chilly
2	Plant Spacing, m (row × plant)	0. 60×0. 45
3	Average Plant height, m	0.69
4	Time spent, hour	0.78
5	Area covered, m^2	4,800
6	Discharge, Liters/hour	51.1
7	Speed of operation, km h^{-1}	2.52
8	Spraying width, m	2.91
9	Field capacity, ha h^{-1}	0.73
10	Actual field capacity, ha h^{-1}	0.61
11	Filed efficiency, %	83.56
12	Cost of operation, Rs/hour	Rs 92.0/hour

Actual field capacity

For calculating actual field capacity, the time consumed for real work and that lost for other activities such as turning, filling of tank was taken into consideration. Actual field capacity was given the following formula

Actual field capacity (ha h^{-1}) = Actual Area covered (m^2) / Time taken to cover the area

The Actual field capacity of the boom sprayer was 0.61 ha h^{-1} observed.

The Field efficiency & Economics Field efficiency is the ratio of actual field capacity to the theoretical field capacity; field efficiency is expressed in %, [2]. The field efficiency of the boom sprayer was 83.56 %. The overall performance boom sprayer is given in [Table-2] and the cost of production of Boom Sprayer is given in [Table-3].

Table-3 *Cost of Production for Cycle Operated Boom Sprayer*

SN	Particulars	Appxt. Cost (Rs)
1	Sprayer (Double motor)	2,400/-
2	Frame with Painting	2,500/-
3	Hose pipe with fitting	400/-
4	Four Nozzles	150/-
5	Other charges	200/-
	Total	5,650/-

Conclusion

Agricultural technology is changing rapidly. Farm machinery, farm buildings and production facilities are constantly being improved. Cheaper and improved sources of energy are needed for efficient and smooth operations of the facilities. Cycle mounted battery-operated boom sprayer technology is most suitable for energy alternate device for power sprayers. The sources of energy are clean, risk free and constitute no harm to human being and environment. The initial investment and operational cost of Cycle mounted battery-operated boom sprayer was found to be less compare to the existing power sprayer in the market and it was observed that sprayer distribution was uniform throughout the field.

Application of research: The sprayer worked satisfactorily under field conditions. It can also be used for vegetables, row crops and orchard crops to spray chemicals or bio pesticides or herbicides. The developed sprayer was reducing labour drudgery, time and very much suitable for marginal and small farmers. This sprayer was user and eco-friendly.

Research Category: Agricultural Management

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Study area / Sample Collection: GPS Institute of Agricultural Management Farm, Gorinabele, Nelamangala, Bangalore

Cultivar / Variety / Breed name: Capsicum, Onion, Chilly

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Srinivasa rao Ch., Sreenath Dixit., Srinivas I., Sanjeeva Reddy B.,Adake R.V. and Shailesh Borkar (2013) Perationalization of Custom Hiring Centres on Farm Implements in Hundred Villages in India. Central Research Institute for Dryland Agriculture, Hyderabad, Andhra Pradesh 151 p.

[2] Sahay Jagdishwar (2008) Text book of elements of agricultural Engineering, 233-235.

[3] Pimental D. (1995) *Journal of Agricultural and Environmental Ethics*, 8(1), 17–29

[4] Shukla L.N., Sandhar N S., Singh S., Singh J. (1987) *Agricultural Mechanization in Asia, Africa and Latin America*, 18(2), 33-36.