

Performance evaluation of bullock drawn sprayers for soybean crop

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■ **ABSTRACT** : The present study was undertaken to evaluate performance of bullock drawn traction sprayer in soybean crop. Malvi breed bullocks were selected for carting operation research work under front line demonstration (FLD) during 2011-12, 2012-13 and 2013-14, at village Surkheda, Badwan and Mohammadpura of Mandsaur (M.P.) The bullock drawn traction sprayer is capable to cover 6 rows at a stretch with an average field capacity of 0.75 ha/h. The average quantity of chemical solution sprayed per hectare was found to be 394.42 l/ha. An operating pressure was 3.8 kg/cm². The average travel speed of unit was 2.20 kmph. Field efficiency was found 74.2 per cent and labour requirement 2.66 man-hr/ha. There was a significant ($P < 0.05$) increase in all the three physiological parameters (respiration rate, pulse rate and body temperature) as compared to their pre-work values.

■ **KEY WORDS** : Physiological response, Bullock drawn sprayer, Discharge rate, Field capacity

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Application of plant protection chemicals through the equipment for controlling pests, disease, insects and weeds plays an important role. As the chemicals are very costly, the uniform application and effective rate is the main requirement. As the height of crop and its density increases with the stage of crop, the effectiveness of manually operated spraying decreases. The majority of the Indian farmers continue to use draught animals in agriculture. Draught animals play a dominant role in our rural economy. With the modernization of agriculture, the use of mechanical power in agriculture has increased but draught animal power (DAP) continues to be used on Indian farms due to small holdings and hill agriculture. More than 55% of the total cultivated area is still being managed by using draught animals as against about 20% by tractors. Animal draught

power was the first supplement to human energy inputs in agriculture. Cattle and buffalo are the species predominantly used in agriculture operations to pull agricultural implements and devices. However, small and marginal farmers mainly depend on a single or a pair of bullocks. Physiological norms for continuous working of animals without undue fatigue are not available. Farmers are facing the acute labourer shortage during spraying period.

■ METHODOLOGY

The effective application of pesticide for pest control using spraying equipment play an important role. The pesticide distribution in the field by the sprayer is regulated by nozzle spray discharge rate, swath width and walking speed of operator / sprayer machine. The bullock drawn

traction sprayer is operated by a pair of Malvi bullock and spraying equipment is mounted on the cart which is operated by tractive power of the wheels.

Two pistons : Pumps are provided on each ground wheel which is actuated by pulling the cart. During the field trials, the wheel tread of cart was adjusted in such a way that the unit could move in between two rows of crop. The suitable yoke length was also selected and the bullocks freely walked in between two rows of the soybean crop. The boom height was also adjusted in accordance with crop height for effective spraying. The artificial operating pressure was created initially by moving the cart. During field trials, one pair of bullocks (Breed Malvi) was used for pulling the cart and the total working hours were limited to 4 hours. The observations on physiological parameters like respiration rate (no./min), pulse rate (no./min), body temperature ($^{\circ}$ F) were recorded according to the standard clinical procedure every day before starting the operation and immediately after the completion of the work and physical behavioral symptoms were noted before and after work and the fatigue score was developed (Upadhya and Madan, 1985). The total score consisted of 40 points; animals which attained a value of 20 or more were declared fatigued. Statistical analysis was done by using the paired t-test for the statistical analysis of data (Snedecor and

Cochran, 1967).

■ RESULTS AND DISCUSSION

The performance evaluation of bullock drawn traction sprayer for spraying on soybean crop was carried out. The performance results are presented in (Table 1) the average discharge of 297.18 l/h was observed at the forward speed of 2.29 km/h at an average pressure of 3.8 kg/ cm^2 . The average field capacity of 0.75 ha/h was observed. The average quantity of chemical solution sprayed per hectare was found to be 394.42 l/ha. The average travel speed of unit is 2.20 kmph. Field efficiency was found 74.2 per cent and labour requirement 2.66 man-hr/ha. During the field trials it is observed that uniformity in spraying has been maintained. The discharge rate of chemical solution mainly depends on operating pressure which in turn is dependent on walking speed of bullock. The decrease in operating pressure also exhibited the low discharge rate of chemical solution. Similar results were also reported by Veerangouda *et al.* (2010) in cotton crops.

Physiological response:

Immediately after work there was a significant ($P < 0.05$) increase in all the three physiological parameters as compared to their pre-work values (Table 2).

Table 1 : Field performance of bullock drawn sprayer for soybean crop

Sr. No.	Parameters	R ₁	R ₂	R ₃	Average
1.	Individual field size, ha	0.40	0.40	0.40	0.40
2.	No. of demonstration	13	13	13	13.00
3.	Total area under demonstration	5.20	5.20	5.20	5.20
4.	Row spacing, mm	350	350	350	350
5.	Plant spacing, mm	45	45	45	45
6.	No. of nozzle	6	6	6	6.00
7.	Nozzle spacing, mm	450	450	450	450
8.	Height of nozzle from the plant canopy, mm	450	450	450	450
9.	Average height of plant canopy, mm	216.4	228.5	222.8	222.6
10.	Swath width, mm	3000	3000	3000	3000
11.	Operating pressure, kg/cm ²	3.5	4.1	3.8	3.8
12.	Discharge rate, l/h	282.34	312.63	296.58	297.18
13.	Forward speed of travel, km/h	2.20	2.16	2.24	2.20
14.	Draft, N (kg)	988.64	997.56	995.38	993.86
15.	Field capacity, ha/h	0.75	0.77	0.74	0.75
16.	Quantity of chemical solution sprayed, l/ha	376.45	406.01	400.78	394.42
17.	Field efficiency (%)	76.6	72.2	73.7	74.2
18.	Labour requirement, man-hr/ha	2.67	2.60	2.70	2.66

Table 2 : Physiological parameters of Malvi bullocks with bullock drawn sprayer			
Parameters	Before	After	Change
Respiration rate (per min)	22.16 ± 0.20	51.58 ± 0.22	29.41 ± 0.31*
Pulse rate (per min)	49.5 ± 0.28	69.41 ± 0.40	19.19 ± 0.58*
Body temp. (°F)	101.40 ± 0.08	102.22 ± 0.07	0.81 ± 0.11*

*indicates significance of value at P<0.05

Table 3 : Physical behavioral symptoms of Malvi bullocks with bullock drawn sprayer								
Parameters	LB	RB	LB	RB	LB	RB	LB	RB
Frothing	(0)	(0)	(2)	(2)	(3)	(3)	(2)	(3)
Leg un-coordination	(1)	(0)	(1)	(1)	(2)	(2)	(3)	(3)
Excitement	(0)	(0)	(0)	(0)	(1)	(2)	(2)	(2)
Inhibition of progressive movement	(1)	(1)	(2)	(2)	(1)	(1)	(1)	(1)
Tongue protrusion	(0)	(0)	(2)	(1)	(1)	(0)	(1)	(2)
Total fatigue score	(6)	(5)	(11)	(10)	(12)	(13)	(14)	(17)

LB= Left bullock

RB= Right bullock

Breed of bullocks: Malvi

Ambient temperature: 30°C

Operating pressure: 5 kg/cm²

Relative humidity: 55%

Average draft: 100 kg

Sunshine Condition: Cool and Cloudy

Work-rest-schedule : 1 hr W - ½ hr R - 1 hr W - ½ hr R - 1 hr W - ½ hr R - 1 hr W (4 working hours)

Respiration rate was found to be affected to a greater extent after draught work followed by pulse rate and rectal temperature. The increase in all three physiological responses after completion of work observed in present study is comparable with the findings of Singh and Upadhyay (1996) in cattle, Yadav and Dhaka (2001), Upadhyay and Madan (1987) in Haryana bullocks. Behera *et al.* (2008) in Surungi bullocks (non-descript breed of Orissa). Similar findings were also reported by, Tomar and Joshi (2008) in Kenkatha bullock, Atakare and Siddiqui (2009) in Deoni bullocks, Shelke and Siddiqui (2009) in Red Kandhari bullocks Singh and Nanavati (2013) in crossbred bullocks and Singh *et al.* (2014) in Malvi bullocks. The bullocks are stressed due to environment and scores upto almost 16 points and therefore, animal fatigue due to environment stress is more important. The data related to physical response of bullocks and fatigue score are presented in (Table 3). The bullock drawn traction sprayer was tested under the work-rest schedule of one hour work and half an hour rest. The results revealed that the fatigue score of 6 and 5 for left and right bullocks, respectively were observed during first hour of operation and progressively increased to 14 and 17, respectively at fourth hour of spraying operation. The bullock's response was within the physiological limits. Similar results were reported by Veerangouda *et al.* (2010) in Khillari breed.

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