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Field evaluation of self propelled reaper cum binder through front line demonstration in wheat crop in Indore district of Madhya Pradesh

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■ **ABSTRACT :** Field performance of self propelled reaper cum binder was assessed in wheat crop and compared with manual method of harvesting by sickle at farmer's field under the front line demonstration during *Rabi* 2015-16 and 2016-17 in the village Ramukhedi, Setkhedi, Khudel and Naharkheda at 20 farmers field. The effective field capacity of the self propelled reaper cum binder was found 0.253 ha h^{-1} with a field efficiency of 59.18 per cent at an average operating speed of 3.5 kmph compared to 0.025 ha ha^{-1} for manual harvesting. The fuel consumption was found 4.97 l ha^{-1}. Labour requirements for mechanical and manual harvesting were 19.97 and 192 man-h ha^{-1}, respectively. The harvesting losses for mechanical and manual harvesting were 69.37 and 68.04 kg ha^{-1}, respectively. The cost of harvesting operation was Rs.9882/ha for manual harvesting and Rs. 2962/ha for mechanical harvesting. The harvesting cost of self propelled reaper cum binder was reduced by 70.02 per cent compared to manual harvesting method with sickle.

■ **KEY WORDS :** Wheat, Self propelled reaper cum binder, Harvesting, Manual harvesting

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Harvesting of crops in India is still done using human labour. However, in some parts of country, harvesting of wheat and rice is carried out using engine power. Wheat and Rice are the two most important staple foods for the people of the Asian countries. Harvesting is one of the major field operations for food grain crops and consumes as much as 20-30 per cent of manual labour requirement. The harvesting process begins when the crop is physiologically matured, to get maximum recovery of grains. Harvesting should be done at an appropriate stage to minimize losses, and to increase the yield. Manual harvesting of field crops is considered a labor intensive operation and takes from cutting to bundle making about 185-340 man-h/ha for wheat or paddy crops (Michael and Ojha, 1987). Due to rapid industrialization and large scale migration to urban areas labour is becoming increasingly scarce and also proving costly. The labour shortage during harvesting resulted in delayed harvest and consequent field grain losses. Mechanization of harvesting is an alternative solution. Farm mechanization will also result in lesser cost of operation. Where farmers have adopted combines for harvesting, alternative straw handling and disposal technology may have to be developed and promoted, as burning of straw is creating environmental pollution and farmers are losing valuable animal feed material. Reaper

harvesters on the other hand are other alternative harvesting equipment, provided straw is considered as economic by-product for animal feed and/or industrial applications (Manjunatha *et al.,* 2009). A few authors reported (Hasanjani *et al.,* 2007 and Chavan *et al*., 2015) that harvesting of rice and wheat crop using reapers have maximum effective field capacity. The harvesting cost of reaper binder in case of paddy harvesting was reduced by 40.74 per cent compared to manual harvesting method with sickle (Jaya Prakash *et al.,* 2015). In recent years, various low and medium cost tractor mounted reapers, self propelled vertical conveyer reaper, self propelled reaper cum binder and many others brush cutters were entered in India for wheat and rice harvesting operation. In central parts of the country, especially in Madhya Pradesh. Most of the farmers of the Indore district of the Madhya Pradesh are resource poor with small land holdings to overcome this problem the big harvesting machines like combine harvester is neither accessible to these farmers nor practically feasible due to small and fragmented lands. Therefore, the main objective of this study was to demonstrate this machine and evaluate the performance of self propelled reaper cum binder suitable for harvesting of wheat for small and marginal farmers.

METHODOLOGY

The performance evaluation of self propelled reaper cum binderwas conducted in farmer's field at village Ramukhedi, Setkhedi, Khudel and Naharheda of Indore and Mhow Tahsil of Indore district in the year 2015-16 and 2016-17 through front line demonstration of Improved/ new agricultural machinery under Krishi Vigyan Kendra, Kasturbagram, Indore. The details of materials used, experimental methodology and measurement techniques adopted during the course of demonstration are presented as follows.

Specifications of self propelled reaper binder:

The self propelled reaper cum binderis developed by M/s. BCS India Pvt. Ltd., Manngarh, Ludhiana which is powered by 8 kW air cooled single cylinder diesel engine. The machine has a cutter bar width of 1.22 m. The function of this self propelled reaper cum binder is harvesting and binding of grain crops having height of 85-110 cm in single operation. The machine harvests crops like paddy, wheat, oats and other crops closed to ground and simultaneously bind the sheaves by using twines. The crop sheaves were ejected in straight line, one behind the other. The cutter bar height and angle is adjustable by adjusting skid screw. The machine has been provided with three wheels. Out of these three wheels two wheels for driving wheels located to the machine and one wheel for steering located at the rear of the machine. The cutter blades are driven by oscillating head which converts rotary motion into reciprocation through the shaft and connecting rod. The machine has a mechanical constant mesh type gear box with four forward speeds.

Evaluation procedure:

The preliminary testing of self propelled reaper cum binder was carried out in the laboratory to check its functional performance, such as working of cutter bar, gathering and knotting devices, speed of cutter bar etc. at Krishi Vigyan Kendra, Kasturbagram, Indore. The field performance, evaluation and demonstrations ware carried out in the various farmer's field of village Ramukhedi, Setkhedi, Khudel and Naharkheda of Indore district for harvesting of wheat crop in the medium black cotton soil. To evaluate the performance of self propelled reaper cum binder the field parameters such as speed of operation, width of operation, total time taken to cover the area, height of cut, effective field capacity, harvesting losses, field efficiency, fuel consumption, labour requirement and economics was worked out as per BIS test code (Singh *et al.*, 2007).

Measurement of all parameters:

Machine and operational parameters:

Operating time for the harvesting operation:

To determine operating time, time was noted from start and finish time of harvesting was recorded. So that actual time required for harvesting by self propelled reaper cum binderwas computed in terms of ha h^{-1}. Time losses while harvesting crop such as time for the adjustments, turning, fuelling etc. were also recorded.

Speed of operation:

To determine the speed of operation, mark the length of 30 m and the reaper cum binder was operated in the marked run length. A stop watch was used to record the time for the harvest to traverse the marked run so that the speed of travel was computed in m s^{-1}.

Theoretical field capacity:

Theoretical field capacity is the rate of field coverage of the machine, based on 100 per cent of time at the rated speed and covering 100 per cent of its rated width. The theoretical field capacity was determined by using the following relationship:

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

Effective field capacity:

Effective field capacity was measured by the actual area covered by the self propelled reaper binder, based on its total time consumed and its width. Effective field capacity was determined by the following relationship:

Effective field capacity (ha h^{-1}) = [(Total area covered, ha) / Total time taken, h)]

Field efficiency:

Field efficiency is the ratio of effective field capacity to theoretical field capacity. It was determined by the following formula:

Field efficiency (%) = [{Effective field capacity,(ha/h)}/ {Theoretical field capacity(ha h^{-1})}]x100

Fuel consumption:

The fuel consumption has direct effect on economics of the machine. The fuel consumption was measured by top fill method. The fuel tank of the reaper cum binderwas filled at its full capacity. The machine was run in the field at constant speed. After completion of harvesting operation, the fuel was refilled in the tank upto the top level. The quantity of refilled fuel was measured by measuring cylinder. This observation was used for computation of fuel consumption in l $h^{-1}$and l ha^{-1}.

Crop parameters:

Harvesting losses: In order to estimate harvesting losses in manual and self propelled reaper cum binder harvesting, first the losses that occur before harvesting (pre-harvest) must be measured. To do this, in four parts of each plot with the usage of a wooden frame with 1mx1m dimensions, all grains fallen within the frame are collected and weighed and the mean of the four measured values were recorded. Harvesting losses include shattering and uncut losses were determined by the following equation (Mohammad Reza *et al.*, 2007).

$$W_t = W_1 + W_2$$

where,

W_t = Total losses, g m^{-2}

W_1 = Shattering losses, g m^{-2}

W_2 = Uncut losses, g m^{-2}

After measuring the amount of losses at different stages, the percentage of harvest losses were determined by following equation:

$$H = \{W_t / Y_g\} \times 100$$

where,

H = Percentage of harvest losses, %

W_t = Total harvest losses, g m^{-2}

Y_g = Grain yield, g m^{-2}

Cost analysis :

The total cost of operation of the self propelled reaper cum binder in Rs. /h was estimated by considering the fixed cost and operational cost of the machine by making following assumptions. The cost of operation was based on the prevailing market rates during the season and location.

Fixed cost :

Fixed cost includes depreciation, interest, housing, insurance and taxes.

Depreciation:

It is the loss of value a machine with the passing of time:

$$D = \{(C-S) / (LH)\}$$

where,

C = Capital cost

D = Depreciation, Rs. /h

S = Salvage value, 10 per cent of capital

H = Number of working hours per year, and

L = Life of machine, year

Interest:

Interest was calculated on the average investment of the machine taking into consideration the value of in first and last year:

$$I = [\{(C+S) / 2\} \times (i / H)]$$

where,

I = Interest per year

i = Interest rate per year, per cent

C = Capital cost

Fuel cost :

Fuel cost was calculated on the basis of actual fuel consumption of the machine.

Repairs and maintenance:

Cost of repairs and maintenance was taken as 5 per cent of the initial investment of the machine.

Other costs:

It includes wages for operator, labour cost based on the prevailing market rates per day of 8 hours.

RESULTS AND DISCUSSION

The reaper cum binder was evaluated for its field performance by harvesting of wheat during *Rabi* 2015-16 and 2016-17 at farmers field. The experiments were carried out in the extent of 0.25 ha for each of 20 farmers of village *Ramukhedi, Setkhedi, Khudel and Naharkheda*. The results obtained during this study such as crop parameters, operating parameters of the machine, pre and post harvesting losses and cost of operation were presented as follows.

Operating parameters:

During the field study the actual field capacity of the reaper cum binder was observed as 0.253 ha h^{-1} with field efficiency of 59.18 per cent at an average operating speed of 3.5 kmph. The fuel consumption was observed as 4.97 l ha^{-1} whereas the effective field capacity for conventional method of harvesting by sickle was observed as 0.025 ha h^{-1}. The results are presented in Table 1

Harvesting loss :

The shattering losses during harvesting with reaper cum binder was 6.937 g m^{-2} whereas 6.804 g m^{-2} for manual harvesting by sickle.

Cost analysis:

The cost analysis for self propelled reaper cum binder was estimated and compared with conventional method of harvesting by sickle. The cost of operation for mechanical harvesting was Rs. 2962/ha as compared Rs. 9882/ha in the case of manual harvesting. The total labour required for harvesting and collection of bundles in the case of mechanical harvesting were 19.97man-h ha^{-1} whereas the total labour required for harvesting, collection and bundle making in case of manual harvesting were 192 man-h ha^{-1}. Based on the obtained results the harvesting cost of self propelled reaper cum binder was reduced by 70.02 per cent compared to manual harvesting method with sickle (Duraisamy *et al.*, 2011).

Conclusion:

During the demonstrations the performance of the self propelled reaper cum binder at the farm was satisfactory. Based on the experimental results during the demonstrations following conclusions are drawn.

Table 1 : Operating parameters of reaper cum binder compared with manual harvesting by sickle

Sr. No.	Parameters	Harvesting type	
		Harvesting with self propelled reaper cum binder	Manual harvesting by serrated sickle
1.	Effective working width, mm	1220	-
2.	Speed of operation, kmph	3.5	-
3.	Area covered, ha h^{-1}	0.253	0.025
4.	Effective field capacity, ha h^{-1}	0.253	0.025
5.	Theoretical field capacity, ha h^{-1}	0.427	-
6.	Field efficiency,%	59.18	-
7.	Fuel consumption, l ha^{-1}	4.97	-

Table 2 : Post harvesting parameters of different harvesting methods

Sr. No.	Parameters	Harvesting type	
		Harvesting with self propelled reaper cum binder	Manual harvesting by serrated sickle
1.	Shattering harvesting losses, (g m^{-2})	6.937	6.804
2.	Uncut losses, (g m^{-2})	0	0
3.	Total losses, (g m^{-2})	6.937	6.804

– The effective field capacity of the self propelled reaper cum binder was found 0.253 ha h^{-1} with a field efficiency of 59.18 per cent at an average operating speed of 3.5 km h^{-1} compared to 0.025 ha h^{-1} for manual harvesting.

– The fuel consumption was found 4.97 l ha^{-1}.

– Labour requirements for mechanical and manual harvesting were 19.97 and 192 man-h ha^{-1}, respectively.

– The harvesting losses for mechanical and manual harvesting were 69.37 and 68.04 kg ha^{-1}, respectively.

– The cost of harvesting operation was Rs. 9882/ ha for manual harvesting and Rs. 2962/ha for mechanical harvesting. The harvesting cost of self propelled reaper cum binder was reduced by 70.02 per cent compared to manual harvesting method with sickle.

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