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Field Performance of Machine for Harvesting of Wheat and Linseed

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ABSTRACT

The actual field capacity of the reaper cum binder to harvest the wheat crop was compared with the harvesting by sickle and Naveen sickle (serrated) .Which reveals that the maximum actual field capacity (0.32 ha/h) was found with the reaper cum binder followed by the Naveen (0.00657) and local sickle (0.00632). The field efficiency of the reaper was found as 87 per cent at different speed of operation. The labour requirement for harvesting by local sickle and reaper cum binder was found as 158 man -h/ha, 152 man-h/h and 3 man-h/ha respectively. The harvesting loss of wheat was found comparatively more (about 1.5%), than the traditional method of harvesting (<1%). Bundling of wheat crop was found good. The field capacity was observed in Ist gear in the gear (2^{nd},3^{rd},4^{th}) the machine was not operated. In Ist - gear no clogging was observed. The performance of the machine with linseed was also not found satisfactory. The harvesting losses of linseed were found comparatively more (about 17%), than the traditional method of harvesting (< 2%) was found. The cost of harvesting of wheat was found maximum with local sickle (3455Rs/ha), followed by Naveen sickle (3324 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (833 Rs/ha). Therefore net saving of Rs 2622 /-per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting. The cost of harvesting of linseed was found maximum with local sickle (3499 Rs/ha), followed by Naveen sickle (3127 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (1180 Rs/ha). Therefore net saving of Rs 2319 /-per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting, but the cost of harvesting of linseed was found more than wheat. During harvesting of wheat, Reaper cum binder consumed minimum energy (236 MJ/ha) than the local (248 MJ/ha) and Naveen (238 MJ/ha) sickle this is due to less fuel consumed in operation.

Key word: *Field efficiency, Harvesting loss, Field capacity, Reaper cum binder*

INTRODUCTION

Harvesting, threshing and transplanting consume about 70% of the total labour requirement. Harvesting operation alone consumes 20% which include harvesting by sickles and bundle making[1]. The farmer in many places has to pay 1/20 to 1/16 of the wheat crop to the farm workers for harvesting operation.

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Manual harvesting is time as well labour consuming and both are scare during the peak harvesting season. The crops are to be harvested in a particular period in order to get maximum return and minimum losses. Delayed harvesting often affects the yield of the next crop also. Ojha and Nath[6] stated that the introduction of efficient harvesting aids and the equipment for the cereals crops seems to be highly necessary to minimize the time of harvesting and the grain loss suffered due to slow rate of work in process of manual harvesting. About 5 –15% loss may occur if proper care is not taken. Usually a stalled person can harvest about 75 kg of paddy per hour. A shattering loss as high as 16% was reported in the case of tractor mower whereas; it was about 7% with sickle. Pitra and Gite[7] conducted survey in three blocks of Bastar district and revealed that harvesting was done manually by sickles when the crop is fairly dried. The tribal farmers have recognition for keeping quality of grain. Since the crop was harvested at low moisture content, the shattering losses were more. During the harvesting time the tribal farmers experience a shortage of man power as a result they cannot harvest their crop in time. This result in increased shattering losses. For harvesting mentioned above, most of the farmers use sickle, which is not serrated. Khanna[3] worked on bullock drawn reaper at Punjab agricultural university, Ludhiana (PAU). An additional provision was made to windrow the harvested crop on one side. An animal - drawn reaper with an engine operated cutting and conveying mechanism was designed and constructed by Singh and Singh[8] for harvesting wheat and rice. The reaper was tested on wheat crop and the capacity was 0.27 ha/h with an observed field efficiency of 84.36% and satisfactory overall performance. Yadav and Yadav[11] design and developed a tractor drawn side mounted reaper. The basic design criterion of the machine was to cut the green crop and form crop brunches. The crop was gathered simultaneously with harvesting and dried for threshing at a later date. A simple tractor-mounted vertical conveyor reaper was developed by Murthy[5] for wheat harvesting. Sheruddin-Bukhari *et al.*[9] studied the grain loss in wheat harvested by a front-mounted reaper-windrower and evaluated during field investigation at 2 sites during 1986. The performance of the reaper-windrower was compared with that of conventional manual harvesting. At the 1st site, the total grain losses by mechanized harvesting average 41.1 kg/ha compared to 84.9 kg/ha from manual harvesting. Labour requirement for machine and manual harvesting and bundling were 31.1 and 85.8 man-h/ha respectively. At the 2nd site, grain losses from machine reaping average 48.0 kg/ha compared to an average of 139.6 kg/ha manual harvesting. Labour requirements for machine and manual harvesting were 28.5 and 88.6 man-h/ha respectively. Howson and Devnani[2] compared the economic feasibility of the harvester for different widths of cut and field grain yields with manual harvesting. Thakur Surinder Singh[10] Studied that management of paddy residues left in the combine-harvested field is a major problem in rice-wheat crop rotation. The study was under taken to develop a paddy stubble harvester-cum-chopper for chopping paddy residues left after by combine harvesting. Mohammad *et al.*[4] reported that Production of appropriate machinery is one of the major factors for reducing labour requirements and production costs of second crop cultivation after rice especially rapeseed. The objective of present study is to study the field performance of the machine for harvesting of wheat and linseed.

MATERIAL AND METHOD

Study area

The testing was carried out during Rabi seasons of 2012-2013 at the research farm of

Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G). The IGKV farm is situated between 20°40'N latitude and 81°39'E longitude with an altitude of 293 m above mean sea level. The climate of this region is dry moist, sub humid and region receives about 1200-1400 mm rainfall annually, out of which about 88% is received during rainy season (June to September) and 8% during winter season (October to February). The temperature during the summer months reaches as high as 480C and drop to 60C during December to January.

Performance evaluation of the reaper cum binder

After testing and setting of machine parameters the performances of the reaper cum binder was assessed in term of field capacity, field efficiency, labour requirement, energy requirement, and quality of work, reliability and comfort, cost and to compare its performance with manual harvesting.

Quality of work

The quality of work is expressed in term of minimum total harvesting loss of the machine and easiness in bundling. The pre harvested losses was also determined at from three places randomly selected within the test area. The area from where the sample was to be collected counted by taking meter in direction of travel and full of half width of cutter bar of the machine. The header loss was determined preferably on that portion of the test area, where the pre harvest losses were determined. Similarly bundling loss was determining from centre position of swath and middle way of cutter bar. The conveying loss comprises the loss caused by collecting and discharging devices. The loss was determined by collecting samples of loose grain and pods or ears fallen outside the crop being cut. The crop after cutting may be allowed to fall on the polythene sheet of 1 m length of sample in the direction of travel in the form of windrow. The samples were analyzed to determine the loss as percent of yield.

Harvesting losses

Harvesting losses included shattering and uncut losses were determined by the following equation.

$$Wgt = Wg1 + Wg2 + Wg3$$

Where, Wgt = Total losses (g/m^2); Wg1 = Pre-harvest losses (g/m^2); Wg2 = Shattering losses (g/m^2); Wg3 = Uncut losses (g/m^2).

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

$$H = \frac{Wgt - Wg1}{Tg} \times 100$$

Where, H = Percentage of harvest losses (%); Wgt = Pre-harvest losses (g/m^2); Wgl = Total harvesting losses (g/m^2); Tg = Grain yield (g/m^2).

Field performance of reaper cum binder for harvesting of wheat and linseed

In order to test the performance of reaper cum binder in Rabi crops for harvesting of wheat and linseed the machine was tested in the IGKV Farm Raipur. Necessary observations were recorded, statistically analyzed and mean value are presented in Table 1 and Table 2. The field performance of the reaper cum binder was determined on the basis of working speed, field capacity, field efficiency, labour requirement, energy requirement and quality of work.

Working speed in wheat field

The machine was tested to harvest wheat and operated in IGKV farm at controllable speed, ranging from 2.48 to 2.57 km/h, the harvesting capacity, field efficiency; fuel consumption and losses were recorded and shown in Table 1. The minimum field capacity (0.314 ha/h) were observed at the lowest forward speed of 2.48 km/h which was obtained at full throttle of reaper with I- gear gave highest field capacity as 0.326 ha/h. It is evident from the data presented in Table 1 that the variation in the speed of reaper had positive effect on the field capacity of the reaper. However the effect of larger speed variation could not be observed due to limitation of field crop, higher speed gave more field capacity and minimum field capacity.

Table 1: Field performance of reaper cum binder for wheat crop

Observations	Speed of operation, km/h	Actual Field capacity, ha/h	Field efficiency, %	Fuel consumption, l/h	Harvesting grain loss, %	Labour required man-h/ha
1	2.48	0.314	85.82	1.10	2.17	3.17
2	2.57	0.326	88.93	0.98	1.66	3.06
3	2.52	0.320	87.20	0.96	2.15	3.12
4	2.49	0.316	86.16	0.95	1.60	3.16
5	2.56	0.325	88.58	1.17	2.33	3.07
Mean	**2.52**	**0.320**	**87.34**	**1.03**	**1.98**	**3.12**
S.D	**0.040**	**0.0051**	**1.390**	**0.035**	**0.320**	**0.049**

Actual field capacity with wheat

The actual field capacity of the machine was found to be 0.32 ha/h with SD 0.0051 which was considered normal and satisfactory as shown in Table 1 and Fig.1. The field and crop condition was suitable for harvesting. This field capacity was observed in Ist gear in the gear (2nd, 3rd, 4th) the machine was not operated. In Ist - gear no clogging was observed. However, further field capacity more than 0.326 ha/h could be achieved.

Field efficiency

The actual field efficiency obtained at the different speed of the reaper cum binder for wheat harvesting. The field efficiency of the reaper was found as 87% at different speed of operation. It was due to increased effective field capacity as compared to theoretical field capacity of reaper.

Labour requirement

The labour requirement in term of man-h/ha was calculated for the harvesting of wheat. The labour requirement for harvesting of by local sickle, naveen and reaper cum binder, was found as 158 man-h/ha, 152 man-h/ha and 3.12 man-h/ha respectively.

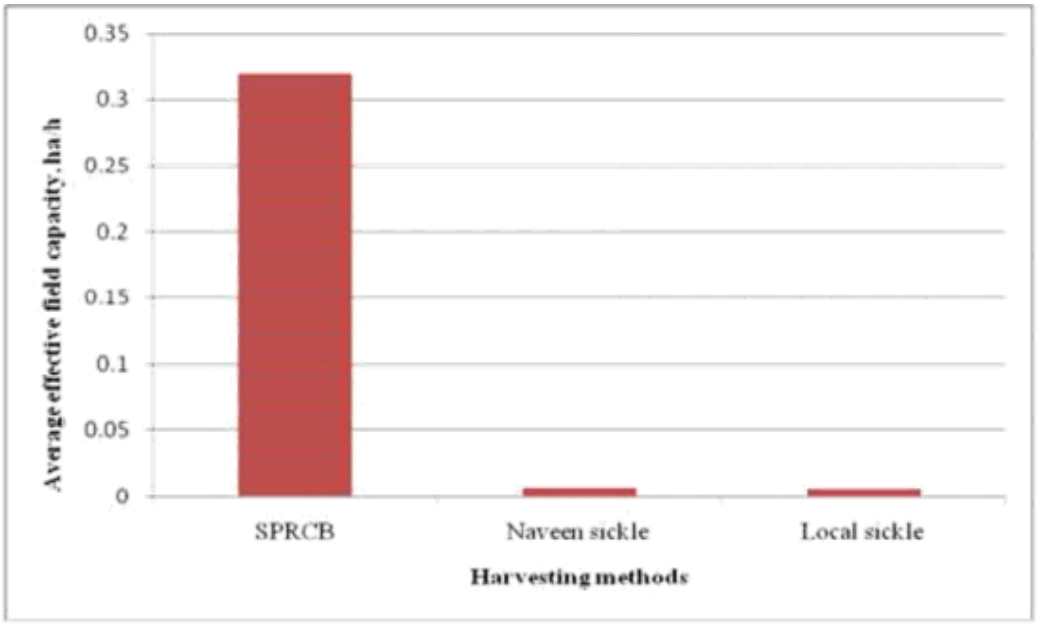

Fig. 1: Average effective field capacity of different harvesting methods of wheat

Fuel consumption

Fuel consumption in liter per hour was measured by the top fill method. An average fuel consumption of reaper cum binder during harvesting operation of wheat was 1.03 l/h.

Energy consumption

The energy consumption during wheat harvesting operation for reaper cum binder depicted in Fig. 2. It reveals that the minimum energy consumed 236 MJ /ha was recorded in case of self-propelled reaper cum binder followed by Naveen sickle 238 MJ/ha and local stickle 248 MJ/ha.

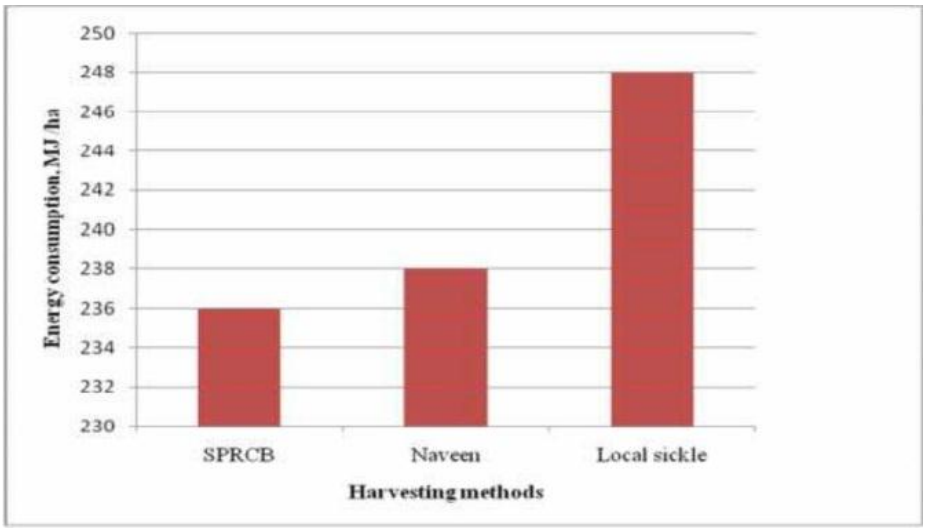

Fig.2. Average energy consumption of different harvesting methods of wheat

Quality of work

The quality of work was evaluated with the traditional manual method. In manual harvesting, using sickle, the harvested crop was windrowed by the farm labours, as a result the number of plants left un-harvested and loss by shattering and conveying was the least. Whereas, in case of self-propelled reaper cum binder the harvesting loss of wheat was found comparatively more (about 1.5%), than the traditional method of harvesting (<1%).

Field performance of reaper cum binder with linseed

The reaper cum binder machine was run on linseed (RLC- 92) at maturity 127 days and dry field condition. The performance of the machine with linseed was also not found satisfactory because during harvesting the crop collecting fork on both left and right side could not collect the harvested crop towards the middle position of binding unit due to more height of fork from ground. Cutter bar also not suited to linseed plant height and thus maximum number of plant remains un-harvested. The result revealed that the field performance of the reaper cum binder was found satisfactory for wheat harvesting and unsatisfactory for linseed. The average field capacity of linseed harvesting is shown in Fig.3.

Table 2: Field performance of reaper cum binder for linseed crop

Observations	Speed of operation, km/h	Actual Field capacity, ha/h	Field efficiency, %	Fuel consumption, l/h	Harvesting grain loss, %	Labour required man-h/ha
1	3.04	0.36	81.74	1.12	16.53	2.71
2	3.10	0.37	83.35	1.20	15.71	2.66
3	2.81	0.34	75.55	1.31	14.48	2.94
4	2.72	0.32	73.13	1.11	21.73	3.03
5	3.09	0.37	83.08	1.25	17.43	2.67
Mean	2.95	0.35	79.37	1.19	17.17	2.80
S.D	0.175	0.020	4.700	0.087	2.766	0.170

Quality of work

The quality of work was evaluated with the traditional manual method. In case of self-propelled reaper cum binder the harvesting loss of linseed were found comparatively more (about 17%), than the traditional method of harvesting (< 2%).

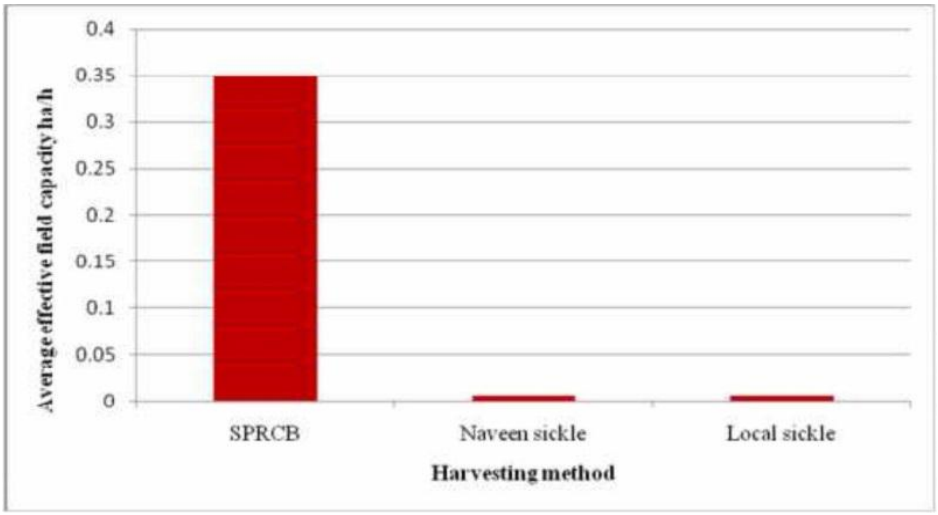

Fig. 3: Average effective field capacity of different harvesting methods of Linseed

Cost economics of the operation of reaper cum binder

In order to determine the economics of the operation of the reaper cum binder, the cost of operation in harvesting is determined. The self-propelled reaper cum binder on the basis of the economics approach to suit the small and medium farmers. The economics of the machine was found as shown in Table 3 and Fig 4. The cost of harvesting of wheat was found maximum with local sickle (3455 Rs/ha), followed by Naveen sickle (3324 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (833 Rs/ha). Therefore net saving of Rs 2622 per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting. The cost of harvesting of linseed was found maximum with local sickle (3499 Rs/ha), followed by Naveen sickle (3127 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (1180 Rs/ha). Therefore net saving of Rs 2319 per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting, but the cost of harvesting of linseed was found more than wheat.

Table 3: Economics of self propelled reaper cum binder for wheat and Linseed

S. No.	Harvesting Machine/method	Labour required, man-hr/ha		Cost of operation, Rs/hr		Harvesting & binding cost, Rs/ha		Additional expenditure Rs/ha	
		wheat	Linseed	wheat	Linseed	wheat	linseed	wheat	Linseed
1.	Reaper Cum Binder	3.12 19.75	2.80 ---	267 ---	267 21.87	833	1180	---	---
2.	Naveen Sickle (serrated)	152	143	21.87	21.87	3324	3127	2491	1947
3.	Local Sickle	158	160	21.87	21.87	3455	3499	2622	2319

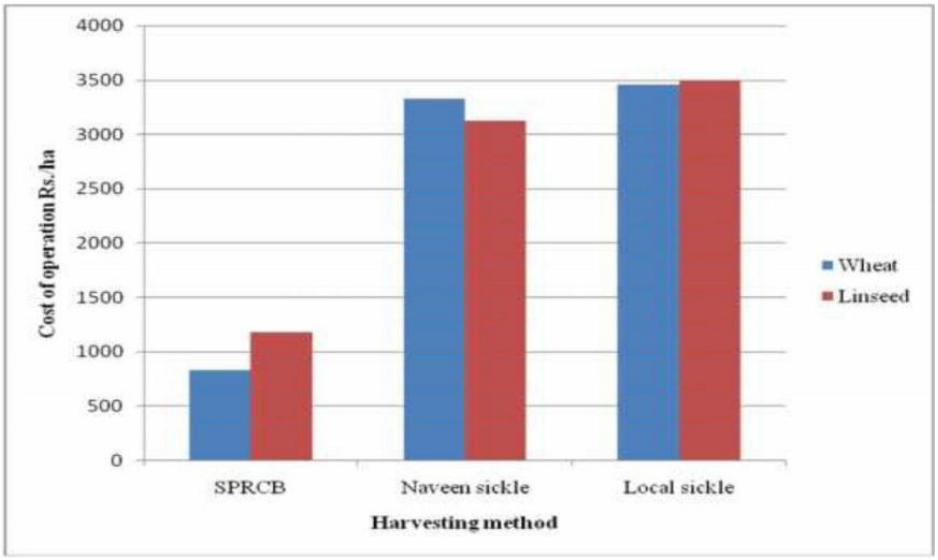

Fig. 4: Economics of self-propelled reaper cum binder for wheat and linseed

CONCLUSIONS

The actual field capacity of the reaper cum binder to harvest the wheat crop was compared with the harvesting by sickle and Naveen sickle (serrated) .Which reveals that the maximum actual field capacity (0.32 ha/h) was found with the reaper cum binder followed by the Naveen (0.00657) and local sickle (0.00632). The field efficiency of the reaper was found as 87% at different speed of operation. The harvesting loss of wheat was found comparatively more (about 1.5%), than the traditional method of harvesting (<1%). The field capacity was observed in Ist gear in the gear (2nd, 3rd, 4th) the machine was not operated. In Ist - gear no clogging was observed. The performance of the machine with linseed was also not found satisfactory. The harvesting losses of linseed were found comparatively more (about 17%), than the traditional method of harvesting (< 2%) was found. The cost of harvesting of wheat was found maximum with local sickle (3455Rs/ha), followed by Naveen sickle (3324 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (833 Rs/ha). Therefore net saving of Rs 2622 per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting. The cost of harvesting of linseed was found maximum with local sickle (3499 Rs/ha), followed by Naveen sickle (3127 Rs/ha) whereas the lowest cost was recorded with the reaper cum binder (1180 Rs/ha). Therefore net saving of Rs 2319 /-per hectare is recorded with the self-propelled reaper cum binder over traditional manual harvesting, but the cost of harvesting of linseed was found more than wheat. During harvesting of wheat, Reaper cum binder consumed minimum energy (236 MJ/ha) than the local (248 MJ/ha) and Naveen (238 MJ/ha) sickle this is due to less fuel consumed in operation.

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