

Feasibility study of operating groundnut decorticator cum cleaner by using bullock power through rotary mode

■ M.K. GHOSAL, D. BEHERA AND A.K. MOHAPATRA

Received : 10.09.2012; Revised : 11.09.2013; Accepted : 12.10.2013

See end of the Paper for authors' affiliation

Correspondence to :

M.K. GHOSAL

Department of Farm Machinery and Power, College of Agricultural Engineering and Technology, Orissa University of Agriculture and Technology, BHUBANESWAR (ODISHA) INDIA

Email : mkghosal1@rediffmail.com

■ **ABSTRACT** : Use of bullocks for agricultural work is limited to tillage, sowing and transportation. The total annual use of bullocks in the state of Odisha is less than 300 hours. But the potential use of bullocks in a year is nearly 800 hours. To enhance the utilization of bullock in the state, there is the need of using bullock power operated stationary machines requiring around 1 hp (0.8 kW) power for doing various post harvest operations like paddy threshing, paddy winnowing, chaff cutting, sugarcane crushing, groundnut decortications, oil expelling, pulse milling and dehusking etc. This would ultimately reduce the economic burden of owning a pair of bullocks. With this aim, a study was conducted for operating a groundnut decorticator cum cleaner with the help of a rotary gear complex, installed in the premises of College of Agricultural Engineering and Technology (CAET), Orissa University of Agriculture and Technology, Bhubaneswar, Odisha. The experiment was conducted continuously for 3 hours with the measurement of physiological responses like respiration rate, heart rate, body temperature etc. of the medium sized non-descript breed of bullocks (pair weight of bullocks 620 kg) of Odisha at half an hour interval and calculation of fatigue score to know their comfortable working without inflicting any health hazards. The bullocks were observed to be loaded with 11.29 % of their body weight in operating the groundnut decorticator cum cleaner and their speed was also measured. The draft and power delivered by the pair of bullocks were as well calculated. The groundnut decorticator cum cleaner was run with a pair of bullocks in rotary mode of operation and two persons were employed for the purpose. The output capacity of groundnut decorticator in rotary mode was observed to be 49 kg per hour as against 60 kg/h in electrically operated motor. The costs of operation in rotary mode and in electrically operated motor were calculated to be Rs. 118.40/quintal and Rs. 63.50/quintal, respectively.

■ **KEY WORDS** : Bullock power, Groundnut decorticator, Physiological responses of bullock, Fatigue score

■ **HOW TO CITE THIS PAPER** : Ghosal, M.K., Behera, D. and Mohapatra, A.K. (2013). Feasibility study of operating groundnut decorticator cum cleaner by using bullock power through rotary mode. *Internat. J. Agric. Engg.*, 6(2) : 335-338.

Odisha is situated in the east coast of India extending over a geographical area of 15.17 mha (million hectares) with 6.55 mha under cultivation. In Odisha, around 77 % of the farmers are under small and marginal categories and they possess about 43 % of the total cultivable land. The numbers of operational holdings are about 40.30 lakhs with a cropping intensity of 160 %. The average size of holding is 1.5 ha. Due to small and scattered holdings and low input capacity, the farmers mainly depend on bullock power for performing different agricultural operations. About 82 % of the total cultivable land is still under the command of the draught animal power and the rest is under tractors and power tillers. Use of bullocks for agricultural work is limited to tillage, threshing and transportation in the state of

Odisha (Kurup, 2003). The total annual use of bullock amounts to less than 300 hours. Cost of utilization is, therefore, very high as the bullocks are to be fed throughout the year whether they are in use or not (Anonymous, 2001). One way to reduce the economic burden of owning a pair of bullocks is to increase the utilization of bullocks which can be possible if the bullocks will be used to carry out operations like running a thresher, winnower, chaff cutter and other agro processing machinery with rotary gear system (Kurchania and Mishra, 2003). This study aims at use of bullock energy particularly during idle period so that their annual use will be increased and ultimately the cost benefit ratio will be improved besides providing useful information on the suitability of bullock power for use of stationary machinery

in rotary mode of operations.

METHODOLOGY

The rotary gear unit has been installed in the premises of College of Agricultural Engineering and Technology, OUAT, Bhubaneswar, Odisha as shown in Fig. A.



Fig. A: Photograph of rotary gear complex

Rotary gear unit :

Gear box:

In the box different parts are assembled, it is made of 6 mm thick pressed mild steel plate. Shape of the box is rectangular having dimensions of 660 x 579 x 274 mm.

Spur gears:

Set of spur gears transmits the power between two parallel shafts. The spur gears are made of heat treated alloy steel having module 4.0 mm. The spur gear has 77 teeth while the spur pinion has 16 teeth. The speed ratio of 1: 4.8 is obtained.

Bevel gears:

Set of bevel gears transmits the power at 90°, they are spiral tooth bevel gear having module 6.5 mm. The bevel gear has 43 teeth and bevel pinion has 7 teeth. The material of the bevel gear is heat treated alloy steel. The speed ratio is 1: 6.14. Combination of bevel and spur gear can produce the speed ratio of 1:29.56.

Shafts:

The first shaft of bevel gear is held in vertical position having diameter 50 mm and 63 mm at bottom side and top side, respectively. The second shaft for bevel pinion and spur gear has diameter of 50 mm. The third shaft used for bevel pinion has diameter of 30 mm.

Bearing:

One ball bearing 90x50x24 size is fitted on the 50 mm shaft and another ball bearing of 72x30x20 mm size is fitted on top of the same. One thrust bearing 60x38x20 mm size is fitted at the outer end of the pinion shaft with two ball bearings of 72x30x20 mm and 88x45x22 mm size.

Bearing cover:

One bearing cover is used for thrust bearing 60x38x20 mm size. The cover is made of 45C8 steel.

Bushes:

Two bushes are used for the input shaft. One is fixed at the bottom plate of the box and the other is fixed at the cover plate. Necessary lubrication arrangement has been provided.

Belt Pulley transmission unit:

The two transmission shafts are mounted on two pillars each. The diameter of the shaft is 50 mm. The first drive shaft was connected to the output shaft of the gear box through universal joint coupling. One pulley of 60 cm was mounted on the first drive shaft and the counter shaft is having a pulley of 35 cm thereby stepping up the speed in the ratio 1: 1.71 when connected with flat belt. For decortication operation, a 40 cm V-pulley is also mounted on the counter shaft which is connected through V-belt with the shaft of groundnut decorticator cum cleaner having a 10 cm pulley, stepping up the speed in the ratio 1: 4. So for decorticator cum cleaner, the final speed ratio is 1:202. The photograph of groundnut decorticator cum cleaner is shown in Fig. B.



Fig. B : Operation of groundnut decorticator cum cleaner through rotary mode by using bullock power

Evaluation of groundnut decorticator cum cleaner :

A groundnut decorticator cum cleaner was used for decortication of groundnut along with cleaning of

Table A : Assumptions for computing cost of operation

Units	Cost (Rs.)	Life span	Repair and maintenance	Annual use (h)
Rotary unit	30,000	10	5 % of the cost	960
Groundnut decorticator cum cleaner	11,460	10	-do-	240
Groundnut decorticator cum cleaner	16,960	10	-do-	240
Bullock pair	20,000	5	Rs5/h	1200

Variable cost for winnowing: Two persons and one bullock operator and labor charge Rs. 100/ day

decorticated groundnut. The groundnut decorticator cum cleaner was tested continuously for 3 hours. The groundnut decorticator cum cleaner can otherwise be operated with a one hp motor. The groundnut decorticator cum cleaner was run with the bullocks in rotary mode of operation and two persons were employed for decortication. Standard techniques were used for measurement of the different parameters. The experiment was conducted for three hours and the observations were taken at half an hour interval. The cost of operation was calculated for decortication in rotary mode of operation through bullocks and compared with electrically operated motor. The following assumptions were taken for calculating the cost (Table A).

■ RESULTS AND DISCUSSION

The data on performance evaluation of the groundnut decorticator cum cleaner in rotary mode have been presented in Table 1. The draft requirement varied 735 N in the beginning to 637 N at the end. The mean draft was 686.70 N which was 11.29 % of the bodyweight of the bullocks. The increase in pulse rate and respiration rate as usual decreased with duration and varied between 48 to 92 and 14 to 48 within three hours, respectively. The corresponding mean values were 74 and 34. There was not much variation in the body temperature. Half hourly RPM of the bullocks were from 50 to 40 and gradually deceased with duration.

The mean linear speed of the bullocks was 2.14 km/h. The mean RPM of the decorticator shaft was observed to be 885. The output of the machine gradually decreased with duration; may be due to decrease in the speed of the shaft of the decorticator. The mean output was found to be 49 kg/h where as the output of groundnut decortications in electric motor operated decorticator cum cleaner was 60 kg/h. The power output was found to be 0.40 kW which indicated that the bullocks could easily do the decortications operation and their utilization could be enhanced. The bullocks could sustain two and half hours of decortications continuously without getting fatigue as the average fatigue score was calculated to be only 19 which was less than the threshold fatigue score of 20.

Cost economics:

The cost economics of rotary mode of operation in decortications is presented in Table 2. The decortications in rotary mode (Rs. 118.40/q) were not economical compared to the same decorticator operated by electric motor (Rs. 63.50/q). The above economics suggests that rotary unit is not economical compared to decortications by electric power but surely it will increase the utilization of bullock which otherwise would have been sitting idle and can save time in the above operations compared to traditional practices. The above operations through rotary mode were found to be

Table 1 : Physiological responses of bullocks and performance of groundnut decorticator cum cleaner in rotary mode of operation

Parameters	Duration, h							Mean
	In	0.5	1.0	1.5	2	2.5	3.0	
Pulse rate, bpm	48	64	70	76	84	86	92	74
Respiration rate, bpm	14	24	30	32	40	44	48	34
Body temp, °C	37.9	38.1	38.2	38.4	38.6	38.7	38.8	38.38
Amb Temp., °C	23.6	24.6	26.4	28.4	28.6	29.6	30.8	27.42
Rh, %	24	23	20	18	18	16	16	19.28
Draft, N	-	735.75	706.32	686.70	686.70	667.08	637.65	686.70
RPM of bullocks/0.5h	-	50	50	46	46	42	40	45.66
Speed, km/h	-	2.35	2.35	2.16	2.16	1.97	1.88	2.14
RPM at decorticator shaft	-	950	900	900	860	860	840	885
Breakage, %	-	4.2	4.0	3.92	3.90	3.86	3.86	3.95
Output, kg/h	-	50	52	50	48	48	46	49
Power output, kW	-	0.48	0.46	0.41	0.41	0.36	0.33	0.40
Fatigue score	-	14	16	16	17	19	21	17.16

Table 2 : Cost economics of rotary mode of operation in groundnut decortifications

Machine	Fixed cost (Rs./q)	Variable cost (Rs./q)	Total cost (Rs./q)	Total cost (Rs./q)
Rotary unit	7.0	-	7.00	-
Bullock pair	3.91	5.00	8.91	
Man-hr	-	12.50	12.50	
One pair bullock + one labourer	3.91	17.50	21.41	
Groundnut decorticator cum cleaner	4.63	-	4.63	
Decortifications cum cleaning in rotary mode	15.54	42.50 (3 laborers including bullock man)	58.04	118.40
Groundnut decorticator cum cleaner with 1 hp motor	9.10	4.00 (electric cost)	13.10	
Decortifications cum cleaning in 1 hp motor	9.10	29.00 (2 laborers)	38.10	63.50

within the draftability of the bullocks.

Conclusion:

- The operations like groundnut decortifications can be performed effectively by using groundnut decorticator cum cleaner in rotary mode by using bullock power to enhance the annual utilization of bullocks.

- The draft requirements of the groundnut decorticator cum cleaner were found to be 11.29 % in terms of percentage of body weight of the medium size bullock. The bullocks could sustain the draft of groundnut decorticator cum cleaner for 2.5 hours.

- The operation of groundnut decorticator cum cleaner through rotary mode was not economical compared to be operated with electric motor. The costs of operation in rotary mode and in electrically operated motor for groundnut decorticator cum cleaner were calculated to be Rs.118.40/quintal and Rs. 63.50/quintal, respectively.

- The output of groundnut decorticator cum cleaner in rotary mode was observed to be, respectively 49 kg/h as against 60 kg/h in electrically operated motor.

Authors' affiliations:

D. BEHERA AND A.K. MOHAPATRA, AICRP on Utilization of Animal Energy, College of Agricultural Engineering and Technology, Orissa University of Agriculture and Technology, BHUBANESWAR (ODISHA) INDIA

REFERENCES

- Anonymous (2001). Livestock Census Report, Directorate of Animal Husbandry, Cuttack, ORISSA (INDIA).
- Kurchania, A.K. and Mishra, D. (2003)**. Work-rest cycles scheduling in rotary mode of operation for Haryana bullocks. *Agric. Engg. Today*, 27(5-6) : 68-75.
- Kurup, M.P.G. (2003)**. Draught animals in Orissa, livestock in Orissa- the socio economic perspective, pp. 49.


 ★★★★★ of Excellence ★★★★★