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Comparative performance evaluation of high capacity wheat thresher with variable parameters

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■ **ABSTRACT :** This research study was conducted in order to determine and compare the performances of two different high capacity wheat thresher and economic characteristics of threshing for wheat crop. The research was conducted in the farm of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. The treatments under the comparisons were different type of power thresher .Wheat crop which was ready for threshing in the field at SHIATS, Allahabad. Wheat was threshed by high capacity Himanchal and Haramba thresher on different cylinder speeds. Three replications were taken and values of dependent variables were computed to indicate the performance evaluation of high capacity flow through the Himanchal and Haramba wheat thresher were carried out for threshing of wheat w.r.t threshing efficiency, cleaning efficiency, output capacity and total machine losses including broken grain, sieve loss, blown or spilled grain and unthreshed grain. The observation were taken at three drum speeds of 850 rpm, 740 rpm and 685rpm and three feed rate 34kg/min, 36kg/min and 39kg/min at the moisture content of 16.2 per cent and two concave clearances (21mm and 18 mm).The analysis of data and results obtained from the comparative evaluation of both the machines shows that threshing efficiency and cleaning efficiency for machine (M_1) 98.89 per cent and 98.96 and (M_2)99.10 per cent and 99.08 per cent, respectively at the 850 rpm drum speed on given feed rate 39kg/min. The highest machine losses were 10.07 per cent at 34kg/min on 685rpm and lowest grain losses were 6.30 per cent at 39kg/min on 850 rpm. The cost of threshing through the high capacity thresher was obtained Rs. 417.70 per hour and the threshing cost Rs.41.77 per quintal through the Himanchal high capacity wheat thresher and Rs.27.84 per quintal through the Haramba high capacity wheat thresher. It was concluded that there is an inherent advantage of Haramba high capacity wheat thresher over the Himanchal high capacity wheat thresher and manual operation. It is necessary to maximize the use of the machine.

■ **KEY WORDS :** Threshing performance, Wheat, Threshing efficiency, Cleaning efficiency

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India is one of the vast countries in the world today. The population growth rate is much faster than the growth rate in food grain production in the country. In order to feed mammoth population, improved agricultural implements will have to be used to increase the output of farming operation in the country.

India is a vast country, covering about 329 million hectare geographical area of the total geographical area. About 166 million hectare is cultivated land and net area sown is about 142 million hectare. In U.P. about 70 per

cent of total geographical area is under cultivation and scope of land increase under cultivation is not possible whereas, day to day population is increasing. To meet the requirement of food grain, scientific farming is necessary which includes introducing of high yielding varieties, development of irrigation facilities, efficient use of chemicals, fertilizers, insecticides etc. coupled with agricultural mechanization. Agricultural mechanization has resulted timeliness of operation, increased productivities of land apart from removal of drudgery of labour and also increase the economic return to farmer. Major components of agriculture mechanization, besides lift irrigation are tractor and associated farm equipment like tillers, disc harrows, seed drills, harvesting, thresher, and increased usage of combine harvester particularly in Northern region of the country.

Agriculture has been and will continue to be the lifeline of Indian economy. As the largest private enterprise in India, agriculture contributes nearly one fourth of national GDP, sustains live-hood of about two-thirds total population and is the backbone of agro based industry. In food sector alone agriculture contributes about Rs.250 thousand crore annually. Through the modern agricultural technologies India has moved from an era of chronic food shortages and "begging bowl" status upto 1960s to food self-sufficiency and even food exports. The technology led sustainable growth in almost all sectors is important. Since 1950s, the productivity of gains are nearly 3.3 times in food grains.

India is the second largest producer of wheat in the world, with production hovering around 68–75 million tons for past few years. The latest estimated demand for wheat production for the year 2020 is approximately 87.5 million tons, or about 13 million tons more than the record production of 75 million tons harvested in crop season 1999–2000. Since 2000, India has struggled to match that record production figure and thus, faces a critical challenge in maintaining food security in the face of its growing population. The current major challenges facing future wheat production in India are increasing heat stress; dwindling water supplies for irrigation; a growing threat of new virulence of diseases such as wheat rusts (yellow, brown, and black) and leaf blight; continuous adoption of rice-wheat systems on around 11million hectares; changes in urbanization patterns and demand for better quality wheat.

Threshing:

A threshing machine or thresher is a piece of farm equipment that threshes grain, that is it removes the seeds from the stalks and husks. Mechanization of this process removed a substantial amount of drudgery from farm labour.

Thresher machine is used for separating wheat, peas, soybeans and other small grain and seed crops from their chaff and straw. Primitive threshing methods involved beating by hand with a flail or trampling by animal hooves.

A threshing machine is used to separate the grain from the straw and other light materials. It is, essentially, a three-step process: In the first stage, bundles of grain and straw were pitched into the feeder (or hopper). The feeder controlled the rate of feed passing into the machine to prevent overloading.

Threshing is the process of loosening the edible part of grain (or other crop) from the husks and straw to which it is attached. Threshing may be done by beating the grain using a flail on a threshing floor. Threshing machine, also known as a thresher, is a machine used to mechanically separate kernels of grain from chaff and stalks.

Manual threshing:

Use your hands to snap off the seed heads, or cut the seed heads off with pruners, a sickle, or a scythe. Dry the heads or sheaves in your wheat plot for 7 to 10 days before threshing. Time to define some vocabulary you may not know, unless you grew up on a wheat farm. Chaff: The seed heads and straw from the plant.

Timely threshing of crop is essential in plane areas. There is enormous sacristy of machinery and non-availabilityof small size machinery makes the job difficult in plane areas. Farmers use conventional method like hand beating, animal feet trampling for threshing crops. So there is a crucial need of small size wheat thresher which can make bhusa and separate bhusa from grains.The requirement of bhusa making put an essential constraint on designing wheat thresher which could thresh wheat crop efficiently. The peg type cylinders are being used in latest wheat thresher in India for threshing as well as making good quality bhusa. Considering the above points there is a crucial need of small and efficient wheat thresher with maximum threshing and cleaning efficiency along with minimum losses and visible grain damage. In

the existing small wheat thresher developed by Dubey (2004), both cylinder and blower are mounted on a wheat common shaft for which a desired threshing and cleaning efficiency are achieved with a greater percentage of visible grain damage and collective losses. The of bhusa obtained from the thresher was also not in permissible limit, that is why not accepted by local farmers. Keeping in view the above following lab and field-testing of power thresher for wheat crop as per B.I.S. test code evaluated the performance of power thresher. Studied the economic requirement of power thresher.

METHODOLOGY

Independent variables:

Drum speed:

Three different speeds were selected for determining the thresher performance on wheat crop. The selected drum speed for wheat was 850, 740 and 685 rpm.

Feed rate:

The amount of crop materials feed inside the threshing unit will affects the overall performance in terms of threshing efficiency and grain damage percentage. Three feed rates were selected for the wheat crop *i.e.* 34, 36 and 39 kg/min.

Concave clearance:

Two different concave clearances were selected for determining the thresher performance on wheat crop. The selected concave clearance was 21mm and 18 mm.

Dependent variables:

Threshing efficiency:

It is the ratio of threshed grain received from all outlets with respect to total grain input expressed as percentage by weight. The total quantities of material obtained at these outlets were processed for eliminating unwanted materials from the grain. The grain from the straw was separated manually and weighed separately. The grain from outlet was weighed for determining the threshing efficiency using the following eq.1.

$$\text{Threshing efficiency} = 100 - \%\text{ of unthreshed grain} \quad \text{....(1)}$$

Percentage of unthreshed grain:

It is the ratio of total quantity of unthreshed grains from all outlets to the total grain input per unit time and expressed in percentage.

$$\text{Percentage of unthreshed grains} = \left(\frac{D}{A}\right) \times 100 \quad \text{...(2)}$$

where,

A= Total grain input = B + C + D

B= Quantity of clean grain from all outlets per unit time.

C= Quantity of broken grain from all outlets per unit time

D= Quantity of unthreshed grain from all outlets per unit time.

Percentage of blown out grain:

It is the ratio of the quantity of the grain blown out to the quantity of the total grain input by weight.

$$\text{Blown out grain (\%)} = \left(\frac{G}{A}\right) \times 100 \quad \text{....(3)}$$

where,

G= Quantity of clean grain obtained at bhusa outlet per unit time.

A= Total grain input.

Percentage of grain damage :

Grain damage percentage is the ratio of the damaged grain to the total grain in the sample.

$$\text{Grain damage (\%)} = \left(\frac{C}{A}\right) \times 100 \quad \text{....(4)}$$

Percentage of spilled grain:

It is the ratio of the weight of the clean grain obtained at sieve over flow to the total grain input per unit time and expressed in the percentage.

$$\text{Spiled grain (\%)} = \left(\frac{K}{A}\right) \times 100 \quad \text{....(5)}$$

where,

K= Quantity of clean grain obtained at sieve under flow.

A= Total grain input

Cleaning efficiency

Output capacity.

RESULTS AND DISCUSSION

The Department of farm power and machinery was improved day by day improving the quality of grain threshed and minimize the grain losses and also improve the straw quality which is possible by improving the performance evaluation of the wheat power thresher.

However, the desired threshing and cleaning efficiency are achieved with a greater percentage of grain damage. The field testing of the thresher was carried out on the wheat crop. Before the test the thresher was set at 21 mm concave clearance at inlet, 18 mm at middle and 15 mm at outlet. The clearance between suction port and sieve was set at 20 mm for better aspirating action. The parameters such as capacity, threshing efficiency and cleaning efficiency, visible grain damage and non-visible grain damage, sieve loss, blown grain percentage, average length of bhusa and power requirement were evaluated. The test was conducted at The Department of Farm Power and Machinery of Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.) India. The best combinations of cylinder speed, feed rate and blower speed on the selected wheat crop were carried out.

Pre-test observations:

The power requirements of various functional components of the thresher were studied under load and no-load conditions at five different speed of the cylinder. The change in the performance of the thresher e.g. grain output, grain losses, threshing and cleaning efficiencies were determined. These data were analyzed to obtain the optimum speed of the operation. The feed rate was kept constant for each replication at each of the speeds. The cylinder concave clarence was 21 mm and was kept constant throughout.

Crop characteristics of wheat:

The wheat crop on which experiment was conducted was SHIATS farm and all the data for T_1, T_2 and T_3 were taken. The crop characteristics in that wheat field from where the study was conducted are presented in Table 1.

Table 1: Crop characteristics of wheat

Sr. No.	Appearance	Standing crop
1.	Average height of plant, cm	77.67
2.	Average number of plant per m^2	330-355
3.	Average quantity of grain per plants, g	10-15g
4.	Average moisture content of grain,%	16.2%
5.	Average moisture content of straw,%	19%
6.	Grain-straw ratio	1:2-2:3

Performance of threshing:

The performance evaluation of different type of high capacity wheat thresher was conducted for threshing efficiency, cleaning efficiency, grain damage percentage, and total uncollected losses. The observations were taken at three cylinder speeds (850 rpm, 740 rpm and 685 rpm) and three feed rate (34 kg/min, 36 kg/min and 39kg/min) efficiency.

Threshing efficiency:

It is evident from the Fig. 1 and 2 that the cylinder speed of 850 rpm and feed rates 34 kg/min, 36 kg/min and 39 kg/min, the average threshing efficiency was increased with three replications from 98.14 per cent to 98.15, 98.5 per cent to 98.34 and 99.02 per cent to 99.15 per cent. Similarly, for the same range of feed rates, the average threshing efficiency was decreased from 98.40 per cent to 98.05 per cent and 97.24 per cent to 96.97 per cent at cylinder speeds of 740 rpm and 685 rpm, respectively.

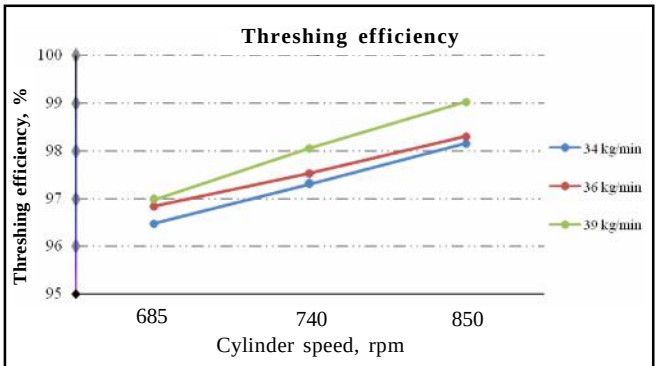

Fig. 1 : Effect of feed rate and cylinder speed on threshing efficiency of high capacity Himanchal wheat thresher

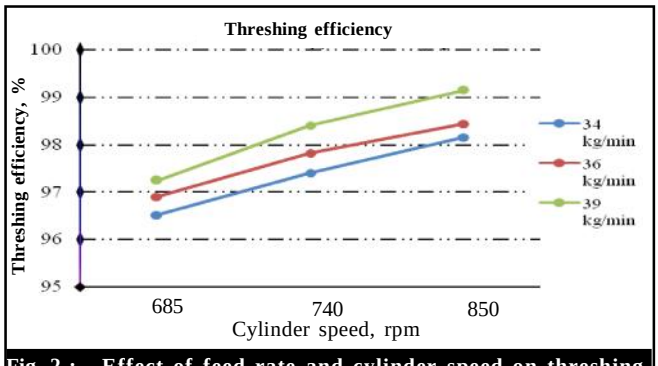

Fig. 2 : Effect of feed rate and cylinder speed on threshing efficiency of high capacity Haramba wheat thresher

Cleaning efficiency:

The results of effect of feed rate, cylinder speed and moisture content on threshing efficiency of high

capacity wheat thresher for wheat crop has been presented in Fig. 3 and 4.

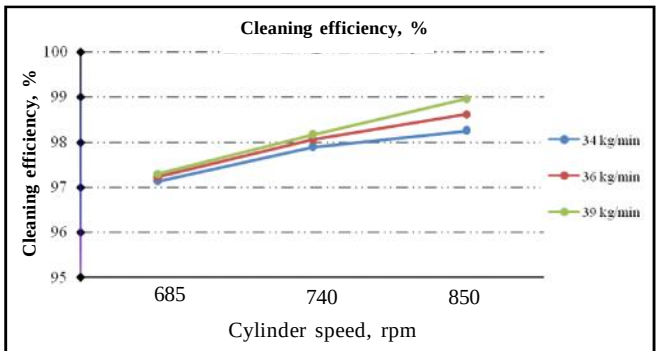

Fig. 3 : Effect of feed rate and cylinder speed on cleaning efficiency of high capacity Himanchal wheat thresher

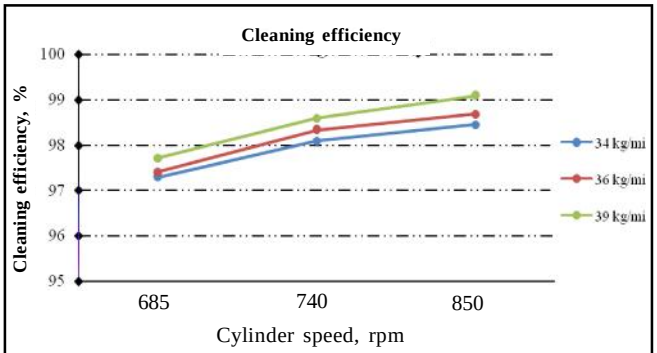

Fig. 4 : Effect of feed rate and cylinder speed on cleaning efficiency of high capacity Haramba wheat thresher

The maximum cleaning efficiency of 99.08 per ent was obtained through to the Haramba high capacity wheat thresher at 39 kg/min feed rate; 850 rpm of cylinder speed whereas the minimum cleaning efficiency of 97.29 per cent was obtained at 34 kg/min feed rate, 685 rpm of cylinder speed. It is observed from the Fig. 4. While in Himanchal high capacity wheat thresher the maximum cleaning efficiency 98.96 per cent was obtained at 39kg/min feed rate:850 rpm of cylinder speed whereas the minimum cleaning efficiency of 97.13 was obtained at 34 kg/min feed rate,685rpm of cylinder speed. It is observed from Fig. 3 that cleaning efficiency increased with the increase in cylinder speed and also increased with feed rate from 34 kg/min, 36 kg/min and 39 kg/min.

Total machine losses percentage

The results of the effect of feed rate, cylinder speed and moisture content on total grain loss percentage in high capacity Himanchal and Haramba wheat thresher for wheat crop has been presented in Fig. 5 and 6.

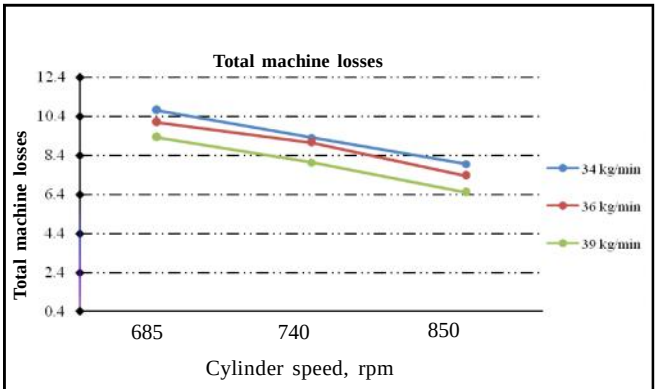

Fig. 5 : Total machine losses of Himanchal high capacity wheat thresher on different feed rate and drum speed (%)

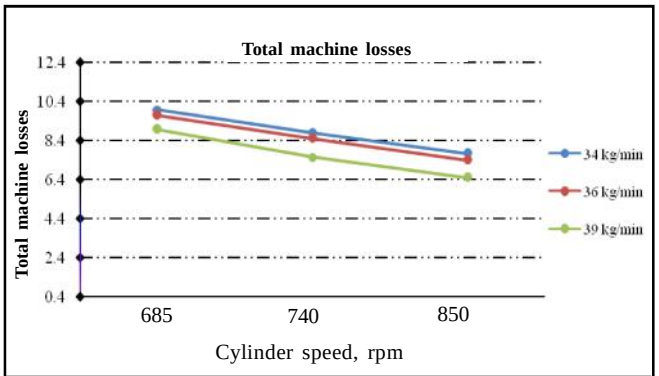

Fig. 6 : Total machine losses of Haramba high capacity wheat thresher on different feed rate and drum speed (%)

The maximum machine losses of 10.07 per cent and 9.66 per cent was obtained at 34 kg/min feed rate; 685rpm of cylinder speed whereas the minimum grain loss of 6.5 per cent and 6.30 per cent was obtained at 39 kg/min feed rate, 850 rpm of cylinder speed. It observed from Fig, 5 and 6 that with the increase in cylinder speed and decrease in feed rate, total machine losses increased.

Grain breakage losses:

The results of the effect of feed rate, cylinder speed and moisture content on grain breakage percentage of high capacity Himanchal and Haramba wheat thresher for wheat crop has been presented in Fig. 7 and 8.

The grain breakage losses were not as the screen size of high capacity wheat thresher. Generally the breakage losses are depending on feed rate and cylinder speed. At the cylinder speed of 850 rpm and feed rates

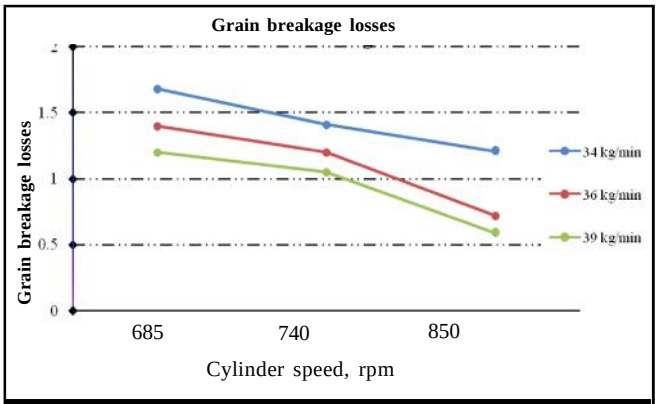

Fig. 7 : Effect of feed rate and cylinder speed on grain breakage losses of high capacity Himanchal wheat thresher

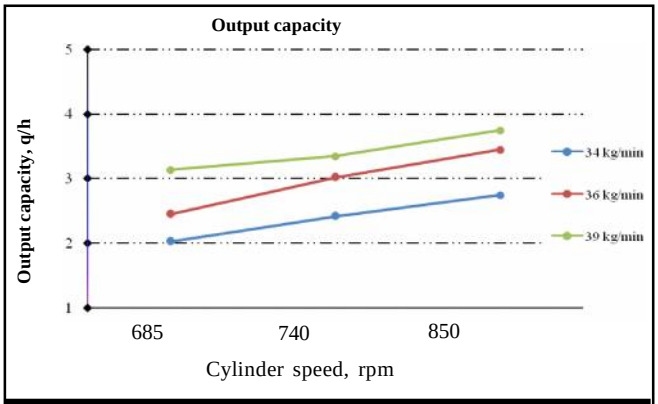

Fig. 9 : Effect of feed rate and cylinder speed on output capacity of high capacity Himanchal wheat thresher

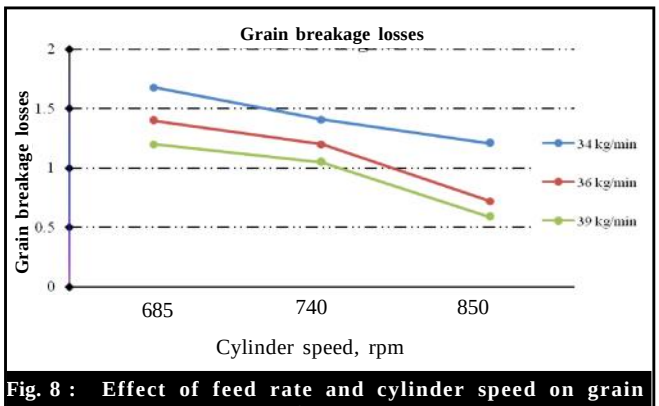

Fig. 8 : Effect of feed rate and cylinder speed on grain breakage losses of high capacity Haramba wheat thresher

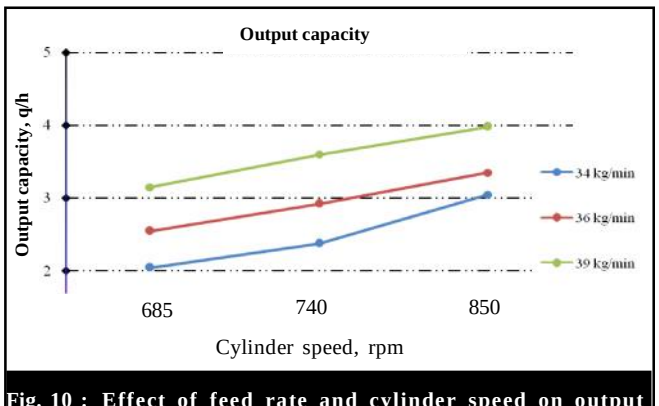

Fig. 10 : Effect of feed rate and cylinder speed on output capacity of high capacity Haramba wheat thresher

of 34, 36and 39 kg/min then average breakage losses were 1.22 per cent, 0.86 per cent and 0.60 per cent in Himanchal wheat thresher and 1.21 per cent, 0.72 per cent and 0.59 per cent in Haramba wheat thresher. Similarly, for the same feed rates, the range of breakage losses was decreased 1.80 per cent to 1.21 per cent and 1.68 per cent to 1.20 per cent at the cylinder speeds of 740 and 685, respectively.

Output capacity:

The results of the effect of feed rate, cylinder speed and moisture content on output capacity of high capacity wheat thresher for wheat crop has been presented in Fig. 9 and 10.

At all feed rates and cylinder speeds, the output capacity ranged from 10 to 11q/h. being at 2.72, 3.15 and 3.68 q/h at 34, 36 and 39 kg/min feed rates at cylinder speed of 850 rpm. Similarly, for the same feed rates, the output capacity was increased 2.4, 2.94, and 3.44 q/h at the cylinder speed of 740 rpm and 2.02, 2.68, 3.13 q/h at cylinder speed of 685 rpm, respectively.

Conclusion:

Effect of variables on performance of Haramba high capacity wheat thresher:

The performance of the high capacity wheat thresher was influenced by changes in variables; speed of drum and feed rate. The independent variables are discussed under:

The results were observed at 16.2 per cent moisture content with 39(kg/min) to the Haramba high capacity wheat thresher at 850 rpm drum speed. They were as follows:

– Threshing efficiency- 99.10 per cent
– Cleaning efficiency- 99.08 per cent
– The highest machine losses were 9.66 per cent

at 34 (kg/min) and 685 rpm.

– The lowest machine losses were 6.30 per cent at 39 (kg/min) and 850 rpm.

– The highest grain breakage losses were 1.68 per cent at 34 (kg/min) and 685 rpm.

– The lowest grain breakage losses were 0.59 per cent at 39 (kg/min) and 850 rpm.

Effect of variables on performance of Himanchal high capacity wheat thresher:

The performance of the high capacity wheat thresher was influenced by changes in variables; speed of drum and feed rate. The independent variables are discussed under :

The results were observed at 16.2 per cent moisture content with 39 (kg/min) to the Haramba high capacity wheat thresher. They were as follows:

– Threshing efficiency- 98.99 per cent

– Cleaning efficiency- 98.96 per cent

The highest machine losses were 10.07 per cent at 34 (kg/min) and 685 rpm.

The lowest machine losses were 6.50 per cent at 39 (kg/min) and 850 rpm.

The highest grain breakage losses were 1.80 per cent at 34 (kg/min) and 685rpm.

The lowest grain breakage losses were 0.60 per cent at 39 (kg/min) and 850 rpm.

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REFERENCES

Dash, S.K. and Das, D.K. (1989). Development of a power operated paddy thresher, *AMA*, **20** (3) : 37-40.

Dubey, M. (2004). Design, development and performance evaluation of a small wheat thresher for hill region. M. Tech. Thesis, G.B. Pant University of Agricultural and Technology, Pantnagar, U.S. Nagar, Uttrakhand (India).

Hassan Ibrahim Mohamed (2005). Sudanese Agricultural Council. Department of Agriculture Engineering, College of Agriculture Studies. Sudan University of Since and Technology. Department of Agriculture Engineering, Faculty of Agriculture, University of Khartoum.

Miah, A. K., Roy, A. K., Hafiz, M. A., Haroon, M. and Seddique S. S. (1994). A comparative study on the effect of rice threshing methods on grain quality. Agricultural Mechanization in Asia, Africa and Latin America.

Mohammad Reza Alizadeh (2009). Iraj BAGHERI Rice Research Institute of Iran (RRII), Rasht, Iran Faculty of Agriculture, University of Guialn, Rasht, *Iran Internat. J. Nat. & Engg Sci.*, ISSN: 1307-1149pp.

Ogunlade, Clement, Aremu, David O. Akinyele, Oluwaseun A. and Babajide (2014). Design, construction and performance evaluation of a coffee (*Coffea arabica*) threshing machine. *Int. J. Engg. Res. & Applic.*,**4** (5):56-64.

Ojha, T. P. and Michael A.M. (2008). Principles of agriculture engineering **1** (6) Jain brother (New Delhi) India.

Olaoye, J.O., Oni, K.C. and Olaoye, M.O. (2011). Computer applications for selecting operating parameters in a stationary grain crop thresher. *J. Agric. Technol.*, ISSN 1686-9141.

Omran Musa Abbass , Omer Mohamed Eltom Elshami and Singhal, Rajeev (2008). *Grassroots Innovations Augmentation Network – North* (GIAN - North) Science Park, Shastri Nagar, Jaipur, Rajasthan, India

Olumuyiwa, B. Ajayi, Buliaminu, Kareem, Olanrewaju, R. Bodede and Oluwasiji, F. Adeoye (2014). Comparative quality and performance analysis of manual and motorised traditional portable rice threshers. *Innovative Systems Design & Engg.*, **5** (4) : 1-7.

Ouézou, Yaovi, Azouma, Makennibe Porosi and Koji, Yamaguchi (2009). Design of throw-in type rice thresher for small scale farmers. *Indian J. Sci. & Technol.*, **2**(9): 9-14, DOI: 10.17485/ijst/2009/v2i9/2951592

Sattar, Muhammad,, Ali, Mushtaq, Ali, Liaqat,, Mueen-u-Din, Masood Qadir Waqar, Ali, Muhammad Anjum and Khalid, Laila (2015). Grain losses of wheat as affected by different harvesting and threshing techniques *Int. J. Adv. Res. Biol.Sci.*, **2** (3):162-170.

Sharma, Mukesh (2010). Farm machinery design principles and problems, 2010, second revised and enlarged edition, Jain Brothers, New Delhi, India.

Sridharam, S.C. (1976). *Design and development of thresher,* Agricultural Engineering, New Delhi, India.