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RESEARCH ARTICLE

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EVALUATION OF ADAPTED SOYA BEAN THRESHER FOR FABA BEAN THRESHING

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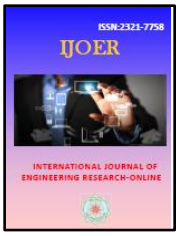

ABSTRACT
Faba bean threshing, in Ethiopia at present, is predominantly manual that employ animal tramping on the ground. Traditional methods require high man-hour, cause fatigue to workers, has low output and reduces the seed quality. In an effort to alleviate some of the problems associated with primary processing of faba bean incorporation of cleaning unit and evaluation of adapted soya bean thresher was done for faba bean threshing. The machine consisted mainly of a frame, threshing drum, mechanical and aerodynamic cleaning unit (sieve and blower), concave and feeding table. The performance of the machine was evaluated in terms of threshing capacity (kg/h), threshing efficiency (%), percentage of loss (%) and percentage of damage (%) at three levels of drum speed of 400, 450 and 500rpm by adjusting the position of fuel control throttle of the engine and 12% mean grain moisture content were used. The results indicated that the threshing capacity and percentage of mechanical damage increased with an increase in drum speed. The maximum threshing capacity of 410.07Kg/hr was obtained at 500rpm drum speed for grain straw ratio of 0.63:1. The percentage of mechanical damage and loss at this operation is 0.21 and 8.40%, respectively. Based on the results obtained, regarding to performance indices, it can be concluded that the machine can be used by the farmers.
Key words: Adaptation, evaluation, faba bean, threshing

INTRODUCTION

Faba bean is one of the most important cool-season food legumes grown in the highlands of Ethiopia, where the soil and weather are considered to be congenial for better growth and development of the crop. The crop takes the largest share of the area under pulses production in Ethiopia. The Central Statistical Agency (2014) reported that faba bean is planted to 4.34% , of the grain crop area with an annual production of about 99.17 quintals, 3.94% of the total grain production and yield of 18.42 q/ha in Ethiopia. It is a crop of manifold merits in the economy of the farming communities in the highlands of Ethiopia and serves as a source of food and feed and a valuable and cheap source of protein, apart from playing a significant role in soil fertility restoration in crop rotation through fixation of atmospheric nitrogen. It is a reliable source of income to the farmers, and earns foreign exchange to the country. It is mainly produced in Tigray, Gondar, Gojjam, Wollo, Wollega, Shoa and Gamo-Gofa regions of Ethiopia

However, the overall productivity of faba bean is affected by many factors including lack of post-harvest technologies, such as threshing (IFPRI, 2010). Faba bean threshing in Ethiopia is mainly carried out using traditional methods. The most commonly employed methods include animal trampling, which leave up to 30% of the crop on the ground and contaminates the remainder with urine

and feces that can reduce the market value Likewise beating with stick is a traditional threshing method experienced by farmers. All these traditional faba bean threshing methods are highly tedious, inefficient; incur huge loss, are full of drudgery and consume time.

In order to overcome the above mentioned problems and improve the working condition of the farmers, Bako Agricultural Engineering Research Center (BAERC) decides to evaluate the adapted soya bean thresher for Faba bean because of their agronomical properties close to each other.

Objectives:

- To evaluate the performance of adapted soya bean thresher for fababean threshing

MATERIALS AND METHODS

Experimental Site

Modification of the machine was done at Bako Agricultural Engineering Research Center (BAERC), which is located in Western Shoa Zone of Oromia National Regional State, Ethiopia. The Center lies between 90 04'45'' to 90 07'15''N latitudes and 37002' to 37007'E longitudes. The evaluation the machine was done at Ambowereda of WestShoa Zone of Oromia.

Description of the Machine Components

The main components of the thresher include feeding table, threshing unit, cleaning unit and grain outlet (Figure 1).

Figure1. The prototype of the thresher

Feeding table

The feeding mechanism of the prototype was radialmechanism that speeds up the intake operation.

Drum

The threshing drum was fixed with 56 pegs - teeth, each peg was 12 mm in diameter and 60 mm in the length. Additionally four inclined blades at inlet and strait blades at chaff out let. The diameter and length of the threshing drum were 440 mm and 800 mm respectively.

Concave

The concave was made of mild steel rods with spacing of 25 mm depended on the size of faba bean grain. The concave clearance between the threshing drum and concave was fixed at 40 mm.

Cleaning unit

The mechanical cleaning unit (sieve) of 12mm hole diameter was used. The sieves specifications were selected according to the maximum dimension for the seed (length). Additionally, it has aerodynamic cleaning unit that is blower of four blades. The air inlet area is adjustable to generate the required air velocity that can be separate the chaff from the grain.

Performance of the prototype

The performance of the machine was evaluated in terms of threshing capacity (kg/h), threshing efficiency (%), percentage of loss (%) and percentage of damage (%)using the following equations;

$$\text{Threshing capacity (kg/h)} = \frac{Q_t}{T_m}$$

$$\text{Mechanical damage (\%)} = \frac{Q_d}{Q_{ud}+Q_d} X100$$

$$\text{Percentage of loss (\%)} = \frac{Lg}{Q_s+L_g} X100$$

$$\text{Threshing efficiency (\%)} = \frac{Q_t}{Q_t+Q_{us}} \times 100$$

Where: Qt – Mass of threshed grain at grain outlet (kg); Tm – time of threshing operation (h); Qus – quantity of unthreshed (kg); Qud - quantity of undamaged grain (kg); Qd - quantity of damaged grain (kg);Qs = quantity of grain sample (kg); Lg – Mass of loss grain (kg);

Statically Analysis

Three levels of drum speed 400, 450 and 500rpm were used to evaluate the performance of the machine by adjusting the position of fuel control throttle of the engine. Full feeding rate (the batch that can full the inlet area) that make the farmer easy while using the machine and 12% measured mean grain moisture content that is close to the

recommended to be threshed (A. Vejasit and V. M. Salokhe, 2004) were used.

The following Data were collected during performance evaluation of the machine

1. Threshed grain were collected at grain outlet, weighed and recorded as Qt in kg;
2. Damaged grains, grains with visible damages, at grain outlet were manually picked, weighed and recorded as Qd. in kg;

Data was subjected to analysis of variance using one way ANOVA (no blocking). Analysis was made using Gen Stat 15th edition statistical software.

RESULTS AND DISCUSSION

Effect of Drum Speed on Threshing Capacity

Figure 3.1 below shows the effect of drum speed on threshing capacity of the machine. The results indicated that the capacity increased with an increase in drum speed. Increasing drum speed from 400 to 450rpm and 450 to 500rpm increases threshing capacity by 1.76% and 1.10% respectively. The maximum threshing capacity of 410.7 Kg/hrwas obtained at 500rpm drum speed for grain straw ratio of 0.63:1. The threshing capacity increased by increasing drum speed from 400 to 500 rpm due to the high impact force between drum and biomass that leads to high separation of grains from pods. A. Vejasit and V. M. Salokhe (2004) had earlier reported that increase in drum speed increased threshing. The same trends also obtained by Adekanye, T. A., A. B. Osakpamwan, and I. E.Osaivbie. 2016.

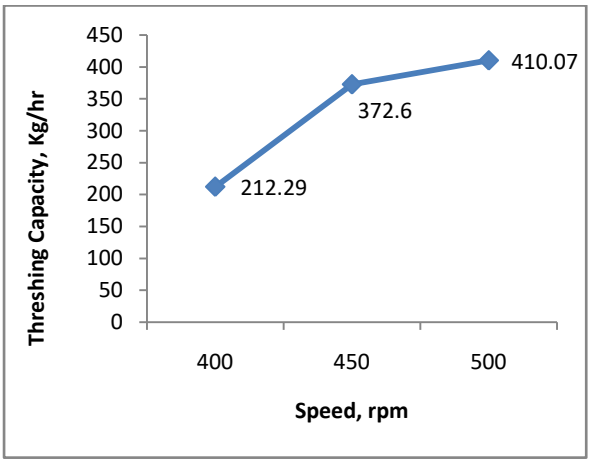

Figure 2.1. Effect of drum speed on threshing capacity

Effect of Drum Speed on Threshing Efficiency

The threshing efficiency of the machine has directed propositional to drum speeds. The maximum threshing efficiency obtained was 96.37%. This find is agreed with that of Adekanye, T. A., A. B. Osakpamwan, and I. E.Osaivbie, 2016 and Vejasit and V. M. Salokhe, 2004. They obtained 99.9% threshing efficiency.

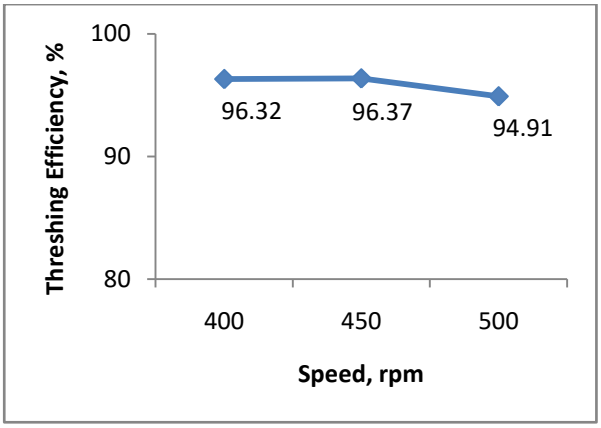

Figure 2.2. Effect of drum speed on threshing efficiency

Effect of Drum Speed on percentage of Mechanical Damage

The result revealed that, Kernel mechanical damage had a direct relationship with the drum speed. This result compares well with the findings reported by Adekanye and Olaoye (2013) for cowpea thresher, Vejasit and Salokhe (2004) for soybean. The maximum percentage of kernel damage of 0.21 % was recorded at the 500rpm drum speed and the minimum 0.05% was recorded at 450rpm drum speed. This finding was close to that of Kowalczuk, 1998. The mechanical damaged he obtained was 5.3% at 18.8 – 23.5m/s peripheral drum speed.

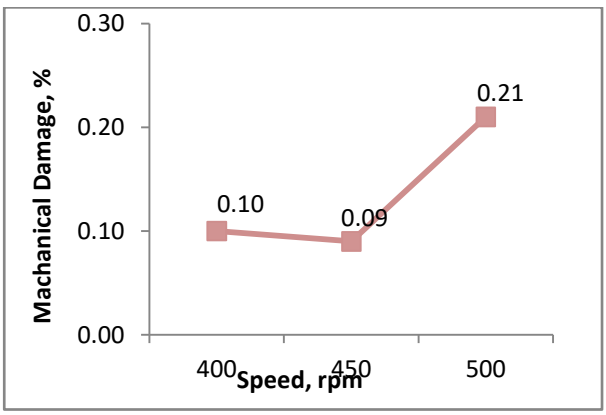

Figure 2.3. Effect of drum speed on mechanical damage

Effect of Drum Speed on Percentage of Grain Loss

The maximum percentage of loss of 8.40 % was recorded at the 500rpm drum speed and the minimum of 3.44% was recorded at 400rpm drum speed. This percentage of grain loss not includes grain damage.

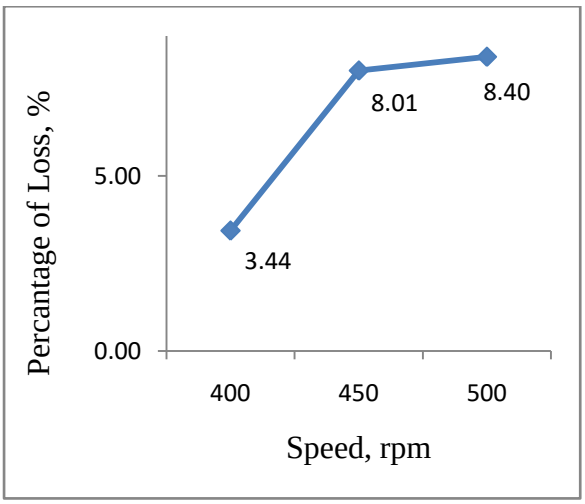

Figure 2.4. Effect of drum speed on percentage of grain loss

SUMMARY AND RECOMMENDATION

Summary

Faba bean threshing, in Ethiopia at present, is predominantly manual that employ animal tramping on the ground. Traditional methods require high man-hour, cause fatigue to workers, has low output and reduces the seed quality. In an effort to alleviate some of the problems associated with primary processing of faba bean incorporation of cleaning unit and evaluation of adapted soya bean thresher was done for faba bean threshing. The maximum threshing capacity of 410.07Kg/hr was obtained at 500rpm drum speed for grain straw ratio of 0.63:1. The percentage of mechanical damage and loss at this operation is 0.21 and 8.40%, respectively. Based on the results obtained, regarding to performance indices, it can be concluded that the machine can solve current problem of the farmers.

Recommendation

From the analysis and discussions of the performance result of the test on the fababean thresher and in order to improve on the performance, the following recommendations should be considered;

1. To improve on the grain damage the drum page should be rubber coated to reduce grain damage.
2. The chaff out let should be modified in order to decrease the percentage of loss

ACKNOWLEDGEMENTS

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