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Research Article

Development of Manually Operated Maize Sheller : A Concept

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ABSTRACT

Maize (Zea mays L.) is one of the important food grains in the country. Shelling is the important post-harvest activity in maize crop for enhancing the quantity and quality of seeds. In peak season there is unavailability of labour or threshing equipments. If the quantity to be harvest is limted then the thresher owner also avoid to harvest such a less quantity of cobs. The local maize cobs harvesting equipments are available but it have some constraints like improper design, lower shelling efficiency, more damage rate and also design is not ergonomically feasible. Also high wages of labour, drudgery for labour, unavailability of labour in peak period, timeliness of operation affects the harvesting of maize cobs. To overcome this issues we have the concept to develop manually operated maize sheller that will be reduced the drudgery of marginal farmers and many other pain points. Also the developed equipment will be ergonomically designed by taking into considerations the various anthropometric parameters of male and female workers. So the developed equipment will be properly designed and efficient. The performance of the maize sheller will be evaluated and will be compared with local or traditional shelling methods viz., hand shelling and tubular maize shelling. The effect of different performance parameters like output capacity, broken grain percentage, cleaning efficiency and threshing efficiency will be discussed. The cost of operation of manually operated maize sheller definitely will be less per quintal than any other traditional methods. So, the technology of manually operated maize sheller will be innovative approach for marginal farmers.

Keywords: *Traditional maize shelling manually operated tubular maize sheller, Shelling efficiency, Collection efficiency, Shelling rate, Moisture content.*

INTRODUCTION

Today India represents a diverse picture in Agriculture development. Agricultural production has increased significantly in last 20 years even as the country's booming population outpaces it. One of the biggest challenges in Indian agriculture is to meet the demand of food grains for the increasing population.

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In India, maize *(Zea mays L*) is the third most important food crop after rice and wheat. According to advance estimate its production is likely to be 27.80 million tonnes mainly during kharif season. Maize is an important cereals crop which belongs to a grass family (Poaceae) producing small edible seeds. Maize contains approximately 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal /100 g. India's yield of maize is approximately 3 tonnes per hectare which put India at 91st place out of 168 maize growing countries.The major steps involved in the processing of maize are harvesting, drying, de-husking, shelling, storing and milling. For the rural formers to maximize profit from their maize, appropriate technology that suites their needs must be used. The processing of agriculture products like maize into quality forms not only prolongs useful life of these product, but increases the net profit farmers make from mechanization technologies such product.

Maize shelling is mainly carried out by using traditional methods. The most commonly employed methods include manual rubbing, maize cobs against one another, using human fingers, biting the cob with wooden plank, treading with animals, likewise the grain can be detached from the cob with the use of pestle and mortal. All these traditional maize shelling methods are highly tedious, inefficient; do not support large scale shelling of maize requiring a lot of labor and time with low productivity as a worker can only shell a few Kg per hour. Grains may cause damage by using traditional methods.

So, the technology of pedal operated tubular maize sheller will be innovative technology for marginal and small farmers. By keeping above points into consideration, research work will be formulated to develop ergonomically feasible pedal operated maize sheller for small farmers.

MATERIALS AND METHODS

The materials and method will consist of an approach for materials and methodology that will be adopted for conducting study, facilities will be developed for performance evaluation of manually operated maize sheller.

The various points will be considered for this study will be mainly,

1) Design of maize sheller
2) Fabrication of components
3) Operating mechanism

Design of maize sheller

The various dimensions of maize sheller will be selected based on physical properties of maize cobs such as unit mass, moisture content, linear dimensions such as length, breadth, thickness, geometric mean diameter, arithmetic mean diameter, cross sectional area, thousand kernel weight, and anthropometric characteristics of workers such as weight, stature, hand length, foot length, functional leg length, sitting height, grip span, grip diameter.

Theoretical considerations

The following assumption will be considered for the development of manually operated maize sheller.

1. The equipment which will be developed should be easy to operate, simple in construction and should have minimum cost.
2. It should be capable of performing shelling the maize cobs.
3. Single person should operate this equipment.
4. The size and weight of equipment should be minimum as compared to other equipment.
5. The time, energy requirement for the shelling of maize cob should be minimum as compare to available equipment.
6. The cost of operation of equipment should be minimum.
7. Grain damage during shelling operation should be minimum.
8. Drudgery during the operation of equipment should be minimum.

Proposed Components

The maize sheller will consist of:

a. Rectangular frame
b. Shelling unit
c. Power transmission unit

i. Pedals
ii. Chain

iii. Drive sprocket
Iv. Ball bearing
d. Cushion Seat
e. Main support
f. . Supporting rods

The base frame will made of MS angle having rectangular section for providing support to all other components. The shelling unit will select based on 20% larger than the maximum diameter of the maize cobs studied. In order to shell the cob, one end of the cob will be insert in to GI pipe with hand rotation. The inner surface of the pipe will be mounted by the ribs longitudinally in four rows which helps to detach the grains. The height of the ribs will be decided based on the length of the maize grains. The power transmission unit will be consists of chain, sprockets, pedals and ball bearing. Machine will operate manually by sitting on the seat and rotating the pedals. The seat will be provided for operator which can be adjusting based on the requirement of operators height. The power transferred through chain sprocket to shelling unit and it initiates the rotation of shelling unit. The shelling unit system will be fitted vertically and the chain sprocket which is attached to cylinder and will be fitted horizontally.

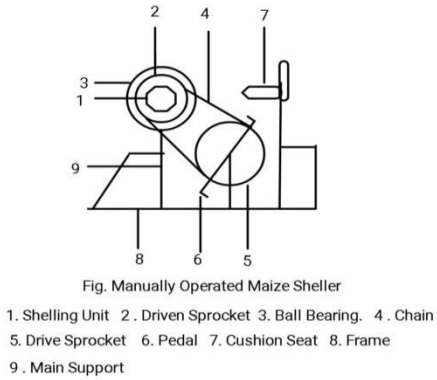

Fig. Manually Operated Maize Sheller

1. Shelling Unit 2 . Driven Sprocket 3. Ball Bearing. 4 . Chain
5. Drive Sprocket 6. Pedal 7. Cushion Seat 8. Frame
9 . Main Support

Fig. 1: Hypothetical view of Manually operated maize sheller

Table 1: Hypothetical design dimensions

Sr. No.	Particular	Materials and Specification	Weight (g)
1.	Rectangular base frame	MS Angle 1400×600 mm	3000
2.	Shelling unit	Stainless steel, (66×44 mm)	150
3.	Ball Bearing	Stainless steel Outer dia. 115 mm Inner dia. 60 mm	1000
4.	Drive Sprocket	Stainless Steel (48 Teeth) Dia. –190 mm	300
5.	Chain	Length -2000 mm	500
6.	Driven sprocket	Stainless Steel (Teeth – 24) Dia. – 95 mm	100
7.	Main frame	MS Angle	4500
8.	Supporting rod	MS Angle	1000
9.	Seat & Cushion	Rubber seat (240 × 220 mm) Cushion (380 × 350 mm)	3000
10.	Handle	MS Angle (400 × 120 mm)	500
Total			**14050 g=14.05 kg**

Expected operation of manually operated maize sheller

Working of manually operated maize sheller before the start of shelling process the machine will set up at place where sufficient space will be available. Two big size bucket filled with cobs will be placed on either sides of machine to facilitate easy access to the worker to pick up the cob. The operator of the maize sheller will start pedaling by sitting on the seat provided and the drive sprocket started pedaling, due to continuous pedaling the power will be transmitted from drive sprocket wheel to driven sprocket wheel through chain therefore shelling units started rotating. The operator pick-up the cobs from the buckets placed on either side and put them into the rotating shelling units by their hands. The rotating motion of the shelling unit shell out the kernels and detached kernels fall on the kernel collection trays from where they got collected through outlet in the bag or container placed below the outlet.

Expected outcomes

1. Higher shelling efficiency
2. Lower damage rate
3. Less time consuming operation
4. Higher shelling rate
5. Ergonomically feasible

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