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**Original Research Article**

# Impact Assessment of PAU Maize Dehuskar-Cum-Sheller with the Local Variety Devaki

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**A B S T R A C T**

The present experiment deals with the field evaluation of PAU maize dehuskar-cum-sheller at different rpm 720, 740, 760 and with different moisture content of maize cob of Devaki variety. This experiment was conducted in the farmer's field of Samastipur region as well as in farm machinery lab of Dr RPCAU, Pusa. During last decade there has been a growing attempt by government to enlarge the area under maize cultivation, because this crop has the ability to thrive under minimal water requirement of 400-600 mm. This is the third mostly cultivable staple food of India. Highest concentration of the crop is found in Uttar Pradesh, Rajasthan, Madhya Pradesh, Bihar, Himachal Pradesh, Jammu and Kashmir and Punjab which together account for two-third of the total area and output of the crop. In South India Karnataka and Andhra Pradesh states are the major producers of maize in the county. Madhya Pradesh ranks first in the production of maize in the country, followed by Andhra Pradesh, Karnataka, Rajasthan, Uttar Pradesh and Gujarat. These six states together account over 67 per cent of the total area and 66 per cent of the total production of maize in the country. Results obtained from this experiment shows that the threshing capacity was found 510 kg/hr with the rpm 740 and with 16% moisture of maize cob. The dehusking capacity was also maximum at 16 % mc of cob was upto 85%. No grain breakage was observed at the average cylinder speed of 740 rpm. A sharp decline in threshing and dehusking efficiency was observed at cob moisture content above 18 %. The cost of use of machine calculated with power source (power tiller) as prime mover has been found rupees 371 per hour or 68.70 per quintal whereas in case of traditional method it was about 375 per quintal. There is a net saving of rupees 306 per quintal with respect to manual threshing.

**Keywords**

Maize Dehusker-cum-Sheller; Moisture Content; RPM; Threshing Efficiency; Dehusking Efficiency; Prime mover; Manual Shelling

## Introduction

The estimated total food grain production in the country has increased from 196.8 million tonnes in 2001-02 to 259.29 million tonnes in 2011-12 (MoA, GoI) recording a CAGR of 3%. Agriculture mechanization has played a vital role in increasing agriculture productivity and overall production. Although the farm mechanization has significantly contributed to the overall productivity of food crops, post-harvest losses have always denied the legitimate benefits from accruing to the farmers.

Bihar is one of the largest maize growing state and the crop was grown primarily as a subsistence crop to meet food needs for a

long time till recently. But now like in nontraditional areas (Karnataka and Andhra Pradesh), it is also grown for commercial purposes (i.e., mainly to meet the raw material requirements of the animal feed sector). It is third largest maize producing state contributing around 10 percent to national production. Around 0.65 million hectare is presently under maize cultivation, which is about 7 per cent of Gross Cropped Area (GCA) in the state and over 13 lakh farmers are engaged in maize cultivation. During 2005-06, the state produced about 1.4 million MT, which is about 5 per cent of the total crop production.

Maize can be utilized in many different forms by converting it into a variety of products, through grinding, alkali processing, boiling, cooking and fermenting, such as corn starch, corn flakes and cereals, ethanol etc. It also has many industrial applications, which can make it a profitable crop in the state. Maize processing and utilization pattern shows that in India, around 60 per cent of the total produce is for animal feed, 28 per cent for human consumption and 12 per cent is used by the industry (*starch, brewery etc*). In Bihar only 8-10% of maize (5% directly by the processors and another 3-5% is being used by road side snack joints etc.) is processed within the state despite the fact that the state has huge and rising marketable surplus. While the area under cultivation, maize production and yield has increased during 1977 to 2007, there are only 8-10 maize processing units in Bihar. They are mainly into milling of flour and production poultry feed. In absence of adequate processing facility, the huge marketable surplus of Bihar, especially in Rabi season depends completely on other states for its consumption. Any obstruction in this trading chain in future may lead into spoilage of that surplus, affecting the entire value chain. Traditionally, dehusking and shelling of maize are carried out by manually which involves a lot of drudgery (*Mudgal et al., 1998, Singh 2010, Naveenkumar 2011, Anonymous 2012*). Mechanization of system gives better output as well as serves as a cost recovery option to minimize or recover operational investments, and is mostly eco-friendly (Kumar and Kumar, 2017). Mechanization need be enhanced substantially in order to meet the recommended level and to enhance the productivity (Kumar *et al.,* 2016). Mechanization has been defined as the use of improved hand and animal operated tools (Kumar *et al.,* 2016). Worldwide almost 85% global consumption of fresh water is lead by agriculture sector and it is expected that distribute of fresh water in agriculture may be reduced by 8-10% because of urbanization and industrialization (Kumar *et al.,* 2016 and Toung and Bhuiyan, 1994).

The output of manual separation reported to be 30 kg/h with shelling efficiency of 80-100% and grain damage of 0 to 8.3% (*Mudgal et al., 1998, Anonymous 2005, Chilur et al., 2014*). Hence, the objective has been taken for evaluation of PAU maize dehuskar-cum-sheller with most suitable speed of the threshing drum and also on suitable moisture content of cob for maximum output.

## Materials and Methods

The PAU maize dehuskar-cum-sheller was tested in the farmer's field as well as in the Farm machinery lab with the same variety Daveki.

## Principle of machine working

The axial flow of un-dehusked maize-cobs flows through clearance zone between cylinder and sieve (concave clearance (C))

due to the helical-pathed squared cum chamfered-lugs rotation (cylinder peripheral speed (S)) on cylinder drum. The cobs bear several movements leads to tearing and abrasion of cobs, which causes the detachment of sheath and grains from cob (*Anonymous 2004, Danfulani 2009, Gole and Shahu 2009*).

The power source for operation of maize dehusker-cum-sheller was 12 HP power tiller. The specification of machine, diameter of main shaft is 51 mm, the peg bolt thickness 9.5 mm, outward projection 85 mm, inward projection 92 mm and clearance between pegs and main shaft is 50 mm and clearance between pegs and concave edge maximum 23mm and minimum 6mm.Cleaning unit contain primary and secondary aspirators. The primary aspirator contain 371×144mm chamber, 4 number of blade with dimension (L×X×T) is 267×178×2.4mm. The secondary aspirator also contains chamber dimension 331×68mm, 4 numbers of blade with dimension 210×102×2mm. The cylinder contains 8 ribs, length of rib is 420 mm and projection inward is 16 mm.

As per Indian Standard (IS 1985, IS 1973), each trial with 25 kg sample feed was done and output samples were collected for 60 seconds form all outlets separately. The total grain input per unit time (Gin) were calculated by summing clean grains, broken grains and un-threshed grains collected over per unit time from all outlets. The dehusking efficiency (DE) was found by ratio of number of dehusked cobs to the total number of cobs used. Similarly, Shelling Efficiency (SE) is the alternative to fraction of un-threshed grain [i.e. 100 – (% of un-threshed grains)]. The un-threshed grain percentage is the ratio of un-threshed grains per unit time from all outlets to Gin. Total losses (Lt) is the sum of the percentage of broken grains, un-threshed grains and blower loss; where, broken grain percentage (db) is the ratio of the quantity of broken grain from all outlets per unit time to the Gin and blower loss is the fraction of summed amount of sound (whole or unbroken) and broken grains come out at chaff outlet of cleaning tray (Fig 1) to Gin (*Akubuo 2002*). The wattmeter used to determine the power consumption at idle and load condition of MDS for particular F to determine the input capacity (kg/kW-h). The input capacity (Ci) is calculated by relation (Eq. 1) shown below. Ci = Amount of material fed, kg Time taken for feeding, h × Average wattmeter reading, kW (Eq. 1) Germination percentage of seeds (G) was determined by the paper towel method as prescribed by International Rules for Seed Testing. The total germination counts (on the fourth and seventh day for I and II counts) were made.

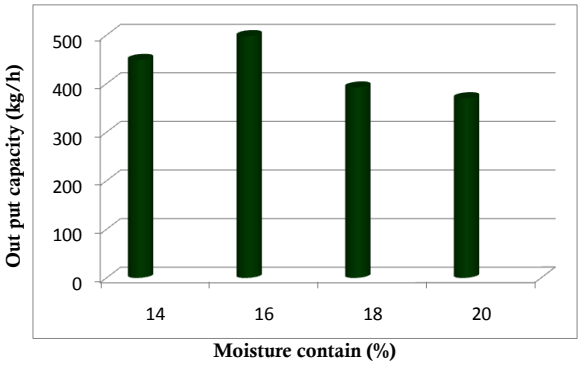
## Results and Discussion

During feasibility testing, the performance of the machine was observed and related data were recorded and the same is presented below under table – 1:

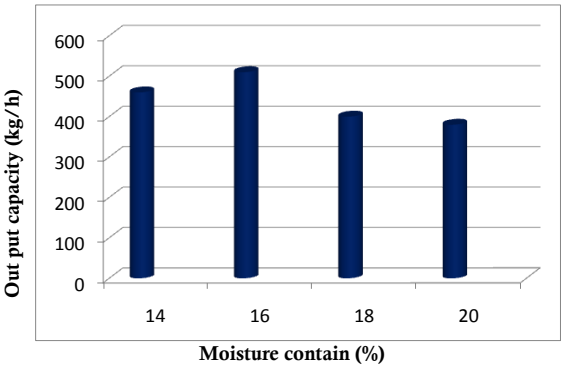
From perusal of the table above, it was observed that the threshing capacity of the machine was between 400–510 kg/h at different moisture content of cob i.e. 14.0 – 20.0% (db), whereas the dehusking efficiency at 16% moisture content and 740 RPM was maximum 85%**.** The Grain breakage and unthreshed grain percentage was minimum at cylinder speed of 740 RPM. The cost of use of machine in Rs371.00./h and Rs. 68.70/q whereas, in traditional method, it was 375.00 Rs./q. The output capacity of the machine at different rpm and different moisture content was also evaluated and the same in presented below in form of graph (column):

**Table.1** Performance of PAU maize dehusker-cum-sheller

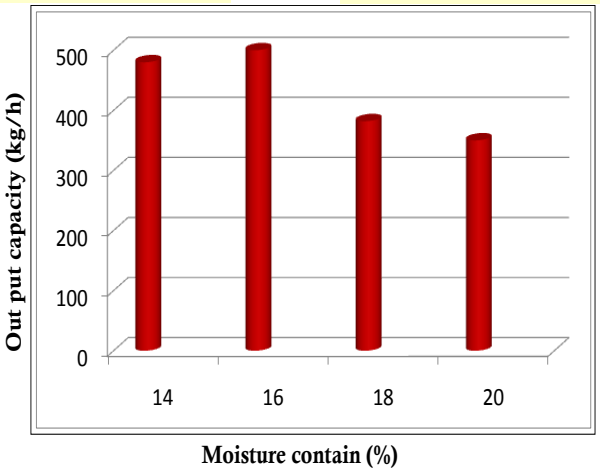
| S. N. | Parameters | Value |
|---|---|---|
| 1. | Power source | Power tiller |
| 2. | Crop variety | Devaki |
| 3. | Grain-cob ratio (including husk) | 0.60-0.64 |
| 4. | Moisture content of cobs, % (db) | 14.0 – 20.0 |
| 5. | Threshing capacity, kg/h | 400 – 510 |
| 6. | Dehusking-cum-shelling efficiency (in %) at moisture content below 18% | 72 – 85 |
| 7. | Cylinder speed, rpm | 720-760 |
| 8. | Cost of use of machine, Rs./hr | 371.00 |
| 9. | Cost of use of machine, Rs./q | 68.70 |
| 10. | Cost of manual threshing Rs./q | 375.00 |
| 11. | Total operational hour under feasibility test | 5 |




Maize dehusker cum Sheller operated at 720 RPM




Maize dehusker cum Sheller operated at 740 RPM




Maize dehusker cum Sheller operated at 760 RPM

**Fig.1** A view of feasibility testing of PAU makes maize dehusker-cum-sheller

**View of Maize dehuskar cum Sheller**

**Operational view of machine**

**Operational view of machine**

**View of maize feeding**

**View of maize**

**View of stone after threshing**

The operational view of the machines during feasibility testing is presented below as Figure – 1.1.

The machine appears to be very useful for the farmers particularly from labour and time saving point of view.

The output capacity was found 510kg/hr (maximum) while that of maize thresher being used by the farmers for dehusked cob (700-800 kg/hr). The dehusking efficiency at 16% moisture content of cob was up to 85%.

No grain breakage was observed at the average cylinder speed of 740.

A sharp decline in threshing and dehusking efficiency was observed at cob moisture content above 18%.

The cost of use of machine calculated with power tiller as prime mover has been found to be Rs. 371/hr or Rs. 68.70 / q.

There is net saving of Rs. 306/q with respect to manual threshing.

The machine attracts the farmers because of its characteristics to conduct dehusking and shelling operation simultaneously.

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