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# Performance evaluation of the developed grader for roasted cashewnuts

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**Abstract**
The cashewnut processing factories are located in rural and backward areas in India. The processing of cashewnuts in these factories are manual and labour-intensive, tedious, time consuming which leads to drudgery in the system. The cashewnut is an irregular shaped nut and causes difficulty for any type of mechanization. An attempt was made to develop a cashewnut grader for roasted cashewnuts for subsequent mechanical shelling operation. In general, the feed rate and the screen efficiency were increased with the speed of the grader pulley and angle of inclination of the screen. The feed rate increased gradually from 7.2 kg/h to 60 kg/h for the change in the slope of the screen from 9° to 12° at 70 rpm. The maximum feed rate of 36 kg/h was observed when the speed of the grader pulley was increased from 80 to 90 rpm for 11° angle of inclination of the screen.

**Keywords:** cashewnut grader, Mechanization of cashewnut processing

## Introduction
Cashew is a major commercial crop with greater export value. India is the largest producer, processor and exporter of cashew kernels. India produced about 7 lakh tonnes of cashews out of 10 lakh tonnes of world production, during 2000-2001. Cashew nut is grown in Andhra Pradesh under cultivated area of 1.03 lakh hectares with a production of 1 lakh tonnes. The cashew industry is typically located in rural and backward areas. The processing of cashew nuts in these factories is labour intensive, tedious, time-consuming which leads to drudgery in the overall development of the cashew nut industry. The general steps involved in cashew nut processing are moisture conditioning, sun drawing of raw nuts, roasting, manual shelling of roasted nuts, kernel drying in the over Burma or also called as Hot House, peeling of kernels, grading of kernels and packaging.

## Materials and Methods
A medium capacity power operated grader was designed and developed for grading roasted cashewnuts into 3 different sizes or grades. The machine is made up of mild steel and consists of a hopper, with feeding mechanism, screens, screen holding frame on railings with oscillating mechanism and eccentric unit for vertical movement. The machine is operated by 1 H.P. electric motor. The screens can be set at any angle from 1° - 12° in the slot provided between the square rods. The screens were made of G.I. sheet of 20 gauge with oblong holes of size (33mm × 20 mm) and (29 mm × 18 mm) were made on the top and bottom screens respectively. The size of the oblong holes were decided based on the width of the roasted cashew nuts.

**Table 1:** Specification of the different components of the developed grader

| S. No | Component | Material and size |
|---|---|---|
| 1 | Hopper | M.S. Sheet 16G (700 x 38) |
| 2 | Shaft | M.S. (25 ϕ, 350) |
| 3 | Shaft | M.S. (22 ϕ, 100) |
| 4 | Pulley | Cast iron (350 ϕ) |
| 5 | Pulley | Cast iron (75 ϕ) |
| 6 | Eccentric pulley | Cast iron (125 ϕ) |
| 7 | Bottom stand | M.S. Angle (37.5 x 6.25 x 3) |
| 8 | Reciprocating frame | M.S square rods (13 x 13) M.S Angle (20 x 20 x 3) |
| 9 | Screen | G.I. Sheet 20G (900 x 500) |
| 10 | Plumber blocks | 25 ϕ |
| 11 | Bearings | 22 ϕ |
| 12 | Railings | --- |
| 13 | V Belt | --- |
| 14 | Motor | 1 HP |
| 15 | Outlet | G.I. Sheet 20G |

(All dimensions are in mm)

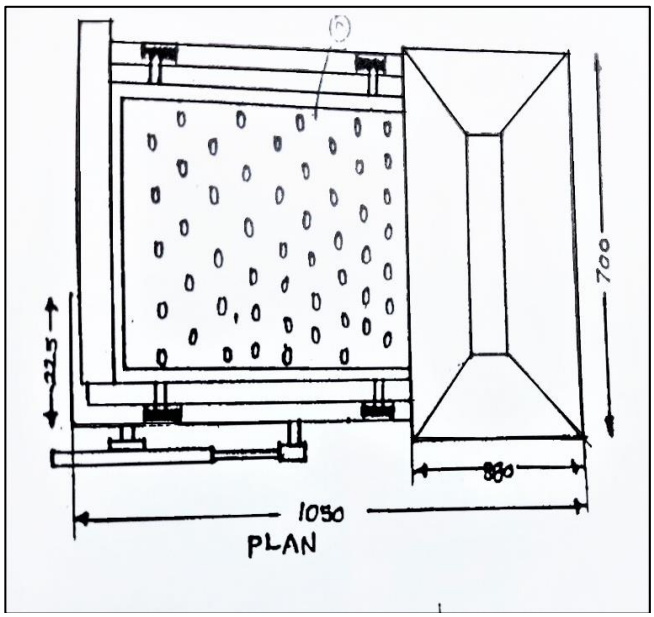


**Fig 1**: Developed Cashew nut grader (plan).

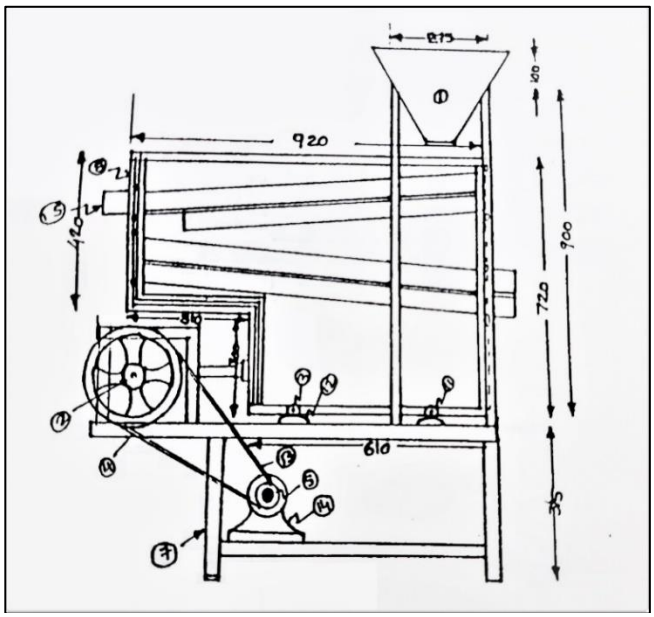


**Fig 2:** Schematic diagram of developed grader, Elevation

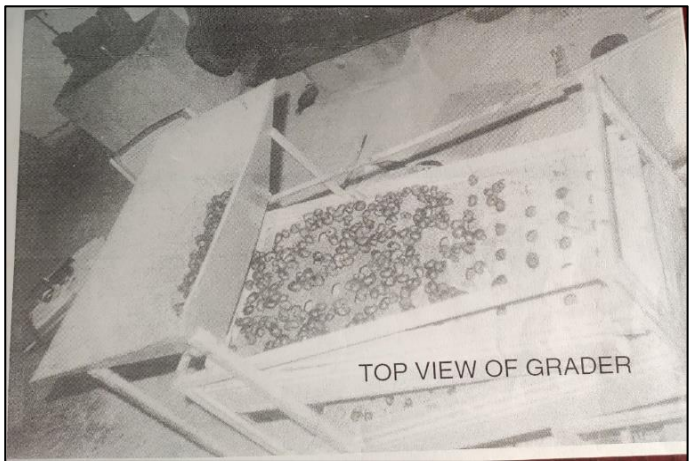


**Plate 1:** Schematic diagram of developed grader

**Experimental Procedure**

The developed cashewnut grader was installed on levelled concrete surface was adjusted by through a rectifier and DC motor and the speed of the grader pulley is measured by the Tachometer directly.

A moderate stroke length of 62.5 mm was selected for the developed grader. The screen efficiency was calculated by the sampling method. 200g of cashew was taken randomly from the 3 outlets and the undersize material weight was subtracted from total weight. The resultant weight divided by total weight. The resultant weight divided by total weight gives the screen efficiency for particular screen, the test was conducted 3 times for each speed at a particular slope and the average values of those screen efficiencies were taken to finalise the screen efficiency.

**Results and Discussions**

The developed cashewnut grader was tested for its screen efficiency and feed rate for different values of angle of inclination of the screen (10°, 11° and 12°) and speed of the grader pulley (70, 80 and 90 rpm).

**Effects of angle of inclination on screen efficiency at different pulley speeds**

It was observed that as the speed of the grader pulley increases the screen efficiency with increase in slope. At the speed of 70 rpm, the screen efficiency was increased gradually from 61.6% to 71.6% for increase in screen slope from 9° to 11°. It was observed that the screen efficiency slightly increased from 71.6% to 72.5% for the increase in slope from 11° to 12°. At the speed of 80 rpm, it was observed that the screen efficiency was increased from 66.6% to 85% for raising in the angle of inclination of screen from 9° to 11°. Whereas between 11° to 12°, the change in screen efficiency was slightly decreased from 85% to 82.58%. At the speed of 90 rpm, the change in the screen efficiency follows the same trend at 80 rpm and angle of inclination from 9° to 11° of screen slope. The screen efficiency was decreased gradually from 90% to 80% for an increase in the angle of inclination from 11° to 12°.

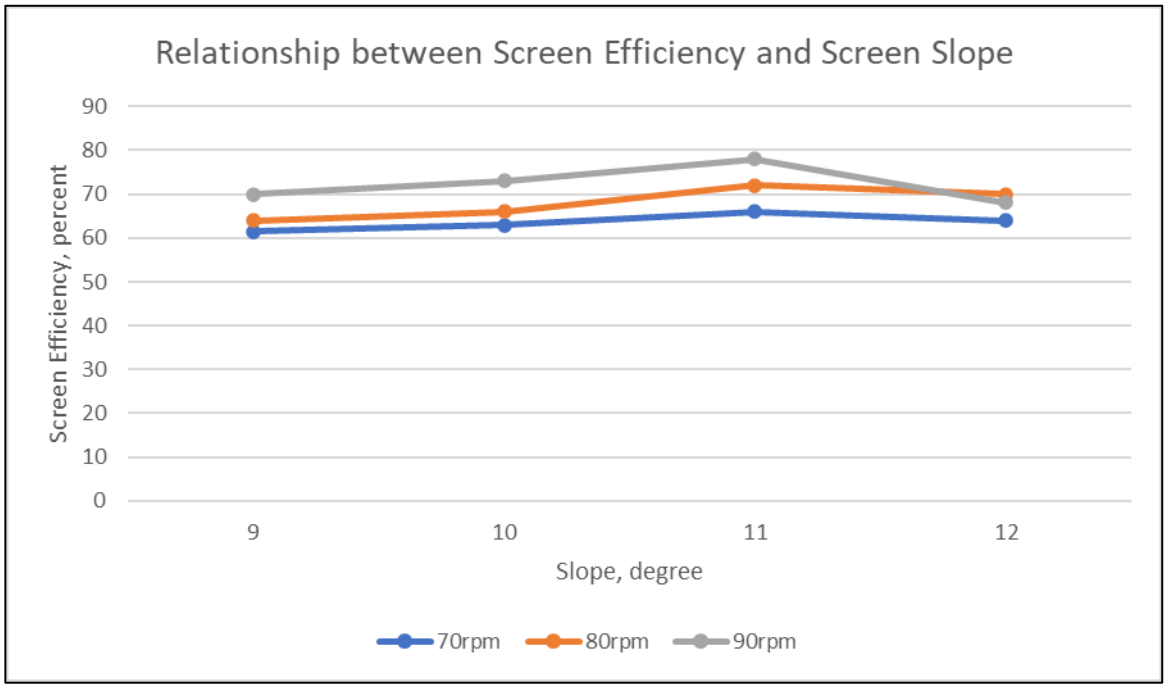


**Fig 3:** Relation between Screen Efficiency and Screen Slope

**Effect of speed of grader pulley on screen efficiency for different slopes of screens**

The relationship between the screen efficiency and speed of pulley reveals that the change in speed of pulley from 70, 80 and 90 rpm, there is a gradual increase in the screen efficiency for any angle of inclination of screen, except at 11°. At the screen of slope of 11°, the screen efficiency increased gradually from 61.6% and 80% for the increase in the pulley speed from 70 to 90 rpm. The difference in screen efficiency was observed 1.7 between 9° and 10° which is less than the difference observed between the screen slopes of 10° and 11° which was 6.3. The efficiency increased about 9% for every change of speed by 10 rpm. The screen efficiency was increased from 66.6% to 90%.

At the screen of slope of 12° the screen efficiency increased from 72.5% to 82.5% from the speed of 70 rpm to 80 rpm.

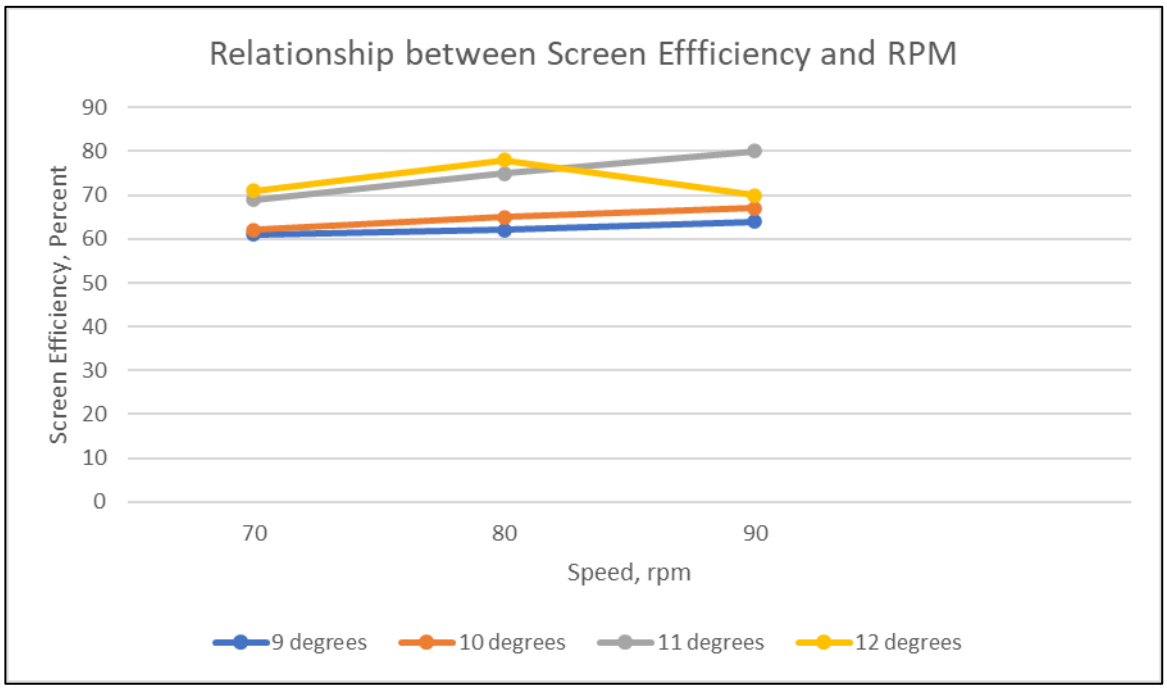


**Fig 4:** Relation between Screen Efficiency and RPM

**Effect of angle of inclination of screens on feed rate at different rpm of grader pulley**

The experiment results indicated that by increasing the screen slope there is an increase in the feed rate. From the results the feed rate increased gradually from 7.2 kg/h to 60 kg/h for the change in the slope of the screen from 9° to 12° at the grader pulley speed of 70 rpm. Feed rate increases gradually with raise in screen slope from 9° and 12° i.e., 9.47 kg/h to 25 kg/h for the pulley speed of 80 rpm. But for the speed of 90 rpm the feed rate increased from 11.25 kg/h to 20 kg/h by changing the screen slope from 9° to 10° whereas there is a sudden increase in feed rate from 20 kg/h to 60 kg/h in raising the screen slope from 10° to 12°.

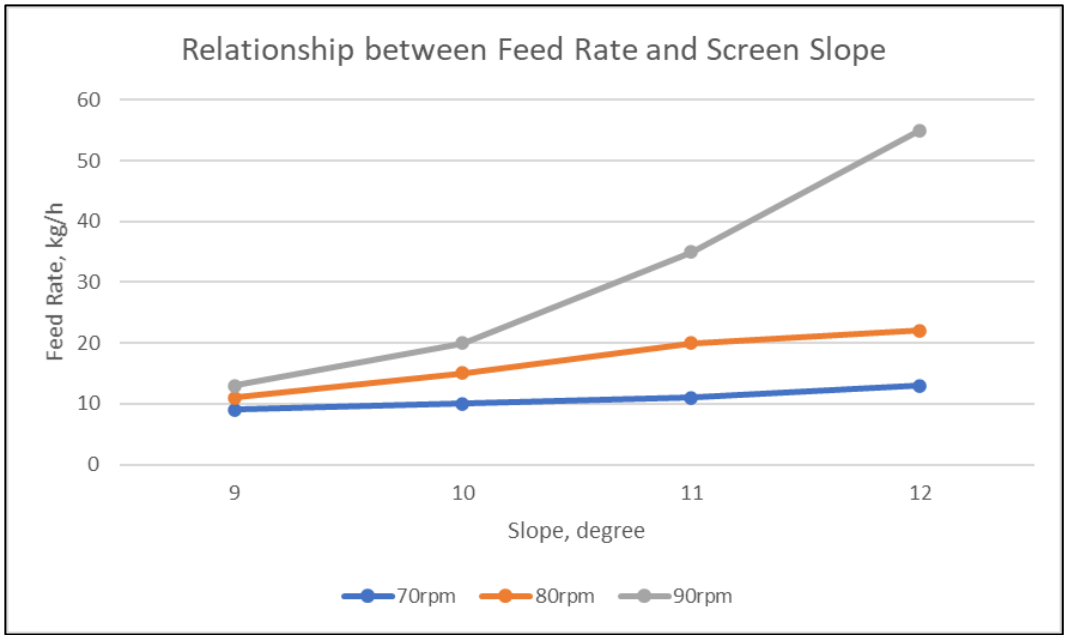


**Fig 5:** Relation between Feed Rate and Screen Slope

**Effect of rpm of grader pulley on feed rate at different angle of inclinations of screen**

The increase in feed rate for the raise in screen slope from 10° to 11° is 16 Kg/h at the grader pulley speed of 90rpm. Whereas the increase in feed rate between the screen slopes at 9° and 10° at 90 rpm is 8.75 Kg/h. The feed rate at the screen sloped of 12°, increases gradually from 18 Kg/h to 25 Kg/h between the grader pulley speed from 70 to 80 rpm. Whereas there is increase in the feed rate of 36 Kg/h by increasing the speed of pulley from 80 to 90 rpm.

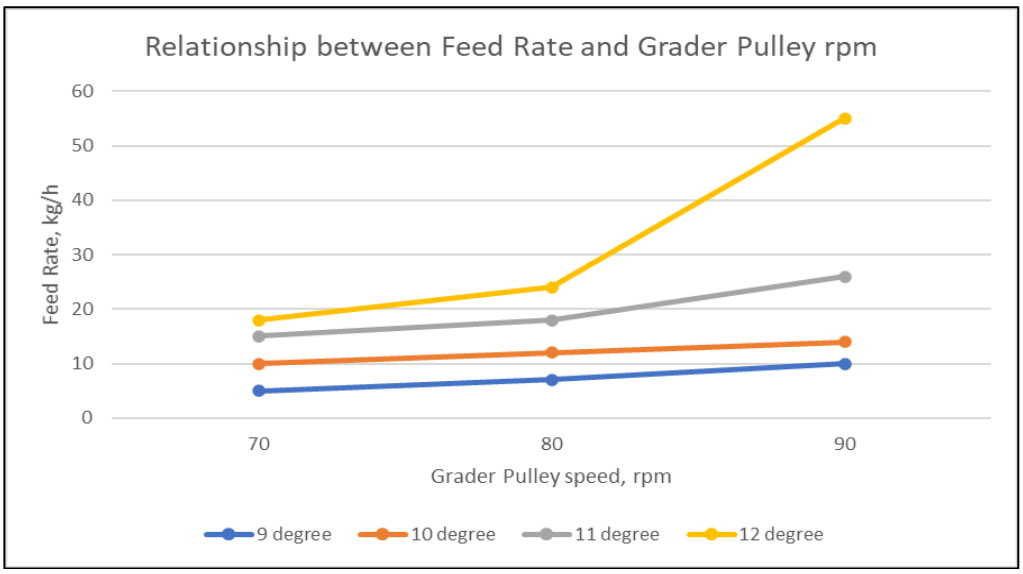


**Fig 5:** Relation between Screen Efficiency and Grader Pulley rpm

## Conclusions

1. The screens are made of G.I sheet. The oblong holes were made on the screen based on thickness of the roasted cashewnuts.
2. The stroke length was observed to be 62.5 mm.
3. The feed rate increases gradually from 7.2 Kg/h to 11.5 Kg/h for the grader pulley speed from 70 to 90 rpm at the screen slope of 9°. The curve of feed rate at screen slope of 10° follows the curve sloped at 9° for the change in speed of pulley ranging from 70 to 90 rpm.
4. A maximum feed rate of 36 Kg/h and screen efficiency of 90% were observed for an optimum combination of angle of inclination of the screen at 11° and the speed of thee grader pulley at 90 rpm.

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