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# Performance evaluation of mahua stamen remover

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■ **ABSTRACT :** Mahua stamen remover was evaluated for its performance. It was tested at four moisture levels (11.9, 13.17, 15.64 and 17.66 % d.b.) and three feed rates (15, 21, 27 kg/h). The stamen removal efficiency and whole flower recovery were determined to optimize feed rate and moisture content of mahua flower for better performance of the machine.The present study revealed that the optimum flower moisture content and feed rate were found to be 13.17 per cent and 15 kg/h, respectively with stamen removal efficiency of 88.23 per cent and whole flower recovery of 81.2 per cent.

■ **KEY WORDS :** Mahua stamen remover, Stamen removing efficiency, Whole flower recovery ans deseeder

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Mahua *(Madhuca indica)* of Sapotaceae family is a large tree found inthe deciduous forest of India. Every part of the mahua tree is used by the tribals for their livelihood. Its flower is used as foods and can be fermented to alcoholic drinks due to its high sugar content. It is a multipurpose tree providing food, fuel, timber, green manure, oil, oil cake, liquor and raw materials for several products and is one of the most important trees of Indian forest. It also has a religious and a high bio-asthetic value in the tribal culture. It is one of those multipurpose forest tree species that provide an answer for the three major Fs *i.e.,* food, fodder and fuel (Banerji and Mitra, 1996). It is very important from the point of view that it can help inpromoting nutritional and economic security in backward areas.

The estimated annual production of mahua flower is around 2 lakh tonnes (*www. jhamfcofed.com*) in Jharkhand. Mahua tree produces edible flowers and fruits. The ripe flowers, which fall from the tree, are collected. The yield per tree ranges from 100-200 kg. Mahua is also famous for its seed oil.

Mahua flower can be utilized in a variety of ways in home, as animal feed and also as raw material for industrial products. They can be used as a sweetener inpreparation of many local dishes like *Halwa, Kheer, Puri* and *Burfi* (Patel and Naik, 2008). It is also used for preparation of bakery and confectionary goods. Tribal people also use it for brewing alcohol. It contains tannin as tannins are excellent antioxidant that helps in giving the structure, texture and flavour to wine. Mahua flowers are also considered good for cooling and are used as a tonic and demulcent. However, an estimated 90 per cent of the production goes into brewing beverages. Mahua has various types of medicinal uses due to its tannin content. It is used as anti-diabetic, antiulcer, hepato protective, anti-pyretic, anti-fertility, analgesic, anti-oxidant, swelling, inflammation, piles, emetic, dermatological, laxative, tonic, anti-burn, anti-earth worm, wound healing headache and many more problems (Patel *et al.*, 2012). On account of various advantages of mahua

flower in terms of composition, it can be exploited for the nutritional benefits and value-added nutritive health foods.

Mahua flower if exploited can yield products of superior nutritional and technological characteristics but till now it has remained as the food, fodder and fuel for the people of lower economic strata in rural areas. The utilization has remained limited to village levels only. Hence, there is an ample scope for diversified uses of mahua at household level and value-added products through appropriate processing technology for incoming generation which can provide alternate employment to rural community. A systematic scientific effort is needed for mahua flower to use it conveniently. By proper harvesting and post-harvest operations market demand for the flower can be enhanced.

However, due to the lack of proper scientific investigation and post-harvest processing technologies, these are collected and sun dried till about 80 per cent moisture is lost, before storage (Patel and Naik, 2008). It has been found that the flower contains hairy stamens inside it which are very bitter in taste and inedible. Therefore, for preparation of any value-added products for human consumption this stamen has to be removed.

Traditionally, people dry the flower in hot summer in courtyard for a day or two. Then, they beat the flower with a wooden plank and aspirate the flower to remove the detached stamen. In this method, most of the flowers get broken / damaged and pressed. There is no equipment available in the market for removing mahua stamen. Hence, a study was conducted to optimize the operating parameters in case of mahua stamen remover developed by Orissa University of Agricultural and technology (OUAT), Bhubaneshwar to obtain the good quality product for preparation of value-added products from mahua.

## METHODOLOGY

### Working mechanism of pedal operated mahua stamen remover:

Mahua stamens were removed using the manual stamen remover developed at the Post- Harvest Engineering and Technology Scheme, Orissa University of Agricultural and technology, Bhubaneswar. Overall dimension of machine was length × width × height (520 x 470 x 1050 mm). The manual stamen remover unit (Fig. 1 and 2) consisted of a cylinder shaft, removing chamber and separating unit.

A pedal operated oscillator is connected to the cylinder shaft. The cylinder is fitted with flat bars that rotate above a stationary concave/housing. The shaft which rotates with the help of bearings provides drive to the shaft of separating unit through the pedal shaft and pulleys. As the mahua flowers are being fed into the removing chamber through the hopper, the stamens are beaten out of the flower and separated. The bulk of the flower falls through the concave into the separating unit which consists of one sieve and one tray that under goes to and fro oscillating motion. The sieve, which has longitudinal holes helps to retain flowers and allows the passage of stamens to fall on the ground.

### Performance evaluation procedure:

Testing of the equipment was carried out at department of agricultural engineering. Test material was collected from village Rarah, district Ranchi. Average moisture content of collected sample was recorded 24.7 % (d.b.,basis). Performance of pedal operated stamen remover was evaluated at four moisture content level (d.b) 11.9 per cent, 13.17 per cent, 15.64 per cent,17.66 per cent and three feed rate (kg/hr) 15, 21, 27. Performance was evaluated on the basis of stamen removing efficiency. Stamen removing efficiency was evaluated as:

$$\text{Stamen removing efficiency (\%)} = \frac{\text{Weight of stamen removed}}{\text{Weight of actual stamen present}} \text{x100}$$

$$\text{Whole flower recovery} = \frac{\text{Quantity of whole flower collected}}{\text{Total flower input}} \text{x100}$$

### Statistical analysis:

Entire data (mean of triplicate) obtained during the experiment was expressed. Analysis of variance (ANOVA) and pair-wise comparison (Fisher's least significant difference (LSD) test were used to compare the means at $P \leq 0.05$ using Microsoft Excel, 2007 (Microsoft corporation, USA).

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Stamen removal efficiency (SRE):

Stamen removal efficiency increased with decrease

in moisture content of mahua flower (Table 1). The highest stamen removal efficiency was recorded 88 per cent at the moisture content of 13.5 per cent at a feed rate of 15 kg/hr and the lowest 68 per cent at 6 per cent moisture content at a feed rate of 16 kg/hr (Table 1). From analysis of variance, it was observed that SRE varied significantly ($p<0.05$) with moisture content and feed rate (Table 3). Effect of the moisture content on the SRE was more pronounced than the feed rate. From Table 1, SRE showed increasing trend in the moisture content range from 11.9 to 13.17 per cent d.b. there after it followed decreasing trend till end. However, in case of feed rate, SRE showed decreasing trend in the feed rate range under study.

**Whole flower recovery (WFR):**

Whole flower recovery percentage increased with increase in sample moisture content at a constant feed rate and reverse trend was seen in case of feed rate at constant moisture content (Table 2). Whole flower recovery decreased steadily below 12 per cent moisture content. The statistical analysis of the data of WRE at different feed rate and moisture content showed that moisture content and feed rate had a significant effect

**Table 1: Mahua stamen removing efficiency at different moisture level**

| Different feed rate (kg/hr) | Mahua stamen removing efficiency (%) | | | |
|---|---|---|---|---|
| | Different moisture (%, d.b.) | | | |
| | 11.9 | 13.17 | 15.64 | 17.66 |
| 15 | 87.18 | 88.23 | 84.43 | 75.23 |
| 21 | 86.15 | 85.76 | 81.78 | 74.12 |
| 27 | 84.78 | 82.63 | 78.53 | 70.58 |
| $LSD_{moisture}$ | 1.68 | | | |
| $LSD_{feedrate}$ | 1.45 | | | |

**Table 2 : Whole flower recovery per cent at different feed rate**

| Different feed rate (kg/hr) | Whole flower recovery of Mahua | | | |
|---|---|---|---|---|
| | Different moisture (%, d.b.) | | | |
| | 11.9 | 13.17 | 15.64 | 17.66 |
| 15 | 61.3 | 70.21 | 75.77 | 81.2 |
| 21 | 60.12 | 68.42 | 74.23 | 78.78 |
| 27 | 59.12 | 67.42 | 72.78 | 76.23 |
| $LSD_{moisture}$ | 1.22 | | | |
| $LSD_{feedrate}$ | 1.06 | | | |

**Table 3 : ANOVA of output of stamen removed fruits (kg/h) at different feed rate and whole flower recovery percentage**

| Source | DF | P value Output of stamen removal (kg/h) | P value of Whole flower recovery (%) |
|---|---|---|---|
| Feed rate | 2 | 0.000685 | 0.000934 |
| moisture | 3 | 5.19e-6 | 1.32e-7 |
| Error | 6 | | |
| Total | 11 | | |

**Table 4 : Comparison of manual and mechanical methods of stamen removal**

| Parameters | Traditional | Pedal operated |
|---|---|---|
| Capacity, kg/h | 3.2 | 15 |
| Stamen removal efficiency, % | 94.6 | 88.23 |
| Whole flower recovery, % | 81.4 | 70.21 |

**Fig. 1 : Stamen removing machine in operation**

**Fig. 2 : Stamen removing machine in operation**

on WFR percentage (Table 3). The moisture content was more effective in influencing the WFR efficiency than feed rate (Table 2). Maximum WFR percentage of 81.2 per cent was recorded in case of feed rate of 15 kg/min at 17.66 per cent (d.b.) moisture content and minimum in case of 27 kg/min at moisture content of 11.9 per cent.

**Comparison of manual and mechanical methods of stamen removal :**

Stamen removal by traditional method was compared with pedal operated stamen removal machine at the optimized condition *i.e.* 15 kg/hr feed rate at 13.17 % (d.b.) (Table 4). Capacity of stamen removal in traditional method was found to be 3.2 kg/h whereas in case of pedal operated stamen removal machine it was 15 kg/h.

**Conclusion:**

The present study revealed that the optimum flower moisture content and feed rate were found to be 13.17 per cent and 15 kg/h, respectively with stamen removal efficiency of 88.23 per cent and whole flower recovery of 81.2 per cent whereas in case of tradition method capacity was observed 3.3 kg/hr with 94.6 per cent stamen and 81.4 per cent whole flower recovery.

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