

PAPER • OPEN ACCESS

Development of Sesbania Slicing Machine for the Production of Artificial Flowers

To cite this article: K Booddachan *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **301** 012038

View the [article online](#) for updates and enhancements.

Development of Sesbania Slicing Machine for the Production of Artificial Flowers

K Booddachan¹ N Bhuwakietkumjohn¹, T Paramethanuwat¹ and P Sriwongras²

¹ Department of Agricultural Engineering of Industry, Faculty of Industrial Technology and Management, King Mongkut's University of Technology North Bangkok Prachinburi Campus, Thailand

² Department of Farm Mechanics, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

E-mail: nipon.b@fitm.kmutnb.ac.th

Abstract. The objective of this research was to develop sesbania slicing machine. There were 3 machinery parts that have been developed; guide rail unit, sesbania feeding lever unit, and pick-up hook set lever unit. The guide rail was shaped into a rectangular unit with 15.4 cm width, 25 cm length, 10 cm height, and 0.5 cm thickness. The sesbania feeding lever unit was a rectangular shape of 50.5 mm width, 240 mm length. The machine was controlled by a 9 mm diameter lever, 330 mm length, and pulled by a guide rail with 24 mm width, 425 mm length. The pick-up hook lever unit set is a stainless steel U-shaped bar with 130 mm width, and 159 mm length which was controlled by a 9 mm diameter lever with 319 mm length. The results showed that the suitable revolution was 60 rpm which can slide sesbania wood at 10 seconds/part. The efficiency of the sesbania slicing machine was 89 percent at 60 rpm. After the experiment of slicing sesbania parts, the obtained thickness of sesbania sheets were 0.6, 0.8, and 1 mm respectively. The results complied with the required criteria.

1. Introduction

Thailand is a country where most of its inhabitants earn their living from agricultural activities. The kingdom's farming produces are consumed domestically as well as being sold internationally. Growing sesbania, a deciduous shrub that can endure environment well, is regarded as one of the farming alternatives. Sesbania are generally found along natural water ways which, in Thailand, consisted of many species such as sesbania javanica, sola plant, and Indian joint vetch. Its flowers are edible which can be consumed directly or after cooking process [1]. Apart from its flowers, stems of sesbania can also be used to produce artificial flowers.

Klong Suan Plu sub-district of Phra Nakhon Si Ayutthaya province, a low plain area, is subjected to yearly flooding between July to December. Most villagers are farmers who grow rice once a year in alluvial plains. Rice fields are infested by, Indian joint vetch, the weeds that grow together with rice. Generally, farmers remove the weeds manually by pulling them from the fields or cut and its stems and left to dry along ridges of their rice fields. Hence, the stem are naturally dried. Subsequently, villagers are aware that if Indian joint vetches were left unprocessed, little benefits would be derived from the plant. Hence, an idea to maximize values of sesbania, the plant has been used as materials in the production of artificial flowers. Dry Indian joint vetch stems were sliced into thin sheets in order to



produce artificial flowers that forms a part of funeral rites for villagers. Consequently, artificial flowers were also produced for other religious ceremonies and traditions as seen in figure1.



Figure 1. Products from sesbania wood.

As a result, beautiful artificial flowers could be achieved from this production process. Such productions could be manufactured at the household industry scale or as a production run by women group in the village. The production can be expanded more due to growing demand in domestic and international markets. Obstacles in the production of artificial flowers were due to manpower shortages, time consuming from knife cutting and inconsistent quality of sesbania sheets from manual slicing method as seen in the figure 2 [2]. As a result, the research team acknowledged the importance of development and designing of a sesbania slicing machine to enhance the cutting and minimize working time. Moreover, the process of preparing sesbania sheets, and the danger from cutting could be reduced while incomes of the farmer groups who sell sesbania trees could be raised.



Figure 2. Slicing sesbania wood by manual method.

1.1. Materials and Methods

There are 4 steps to prepare sesbania for making artificial flowers. These steps were; 1) prepare sesbania wood for cutting, 2) measure and cut sesbania wood into pieces at 100 mm length, 3) use a knife to slice a sesbania piece into a sheet with around 1 mm thickness, 4) bring the sliced sesbania sheets to cut according to the format of artificial flowers. It is necessary to study conditions for design according to the details below:

1.1.1. Study physical property of sesbania wood. The development of the sesbania slicing machine for making artificial flowers was based on a study of basic feature of sesbania parts (stems) which required manpower in the sesbania production. Basic Physical property that were tested were as follow: 1) average length of sesbania parts, 2) diameter size, 3) average thickness of the sesbania sheets after being sliced. All of these factors were used to design the sesbania slicing machine.

1.1.2. Designing of the sesbania slicing machine for making artificial flowers. Must create the sliced sesbania sheets that are similar in size to the ones that are produced manually. This is the essential concept of designing the machine.

Furthermore, the machine must be; able to minimize manpower's working hours, easy to use, and safe for users. The innovation of the sesbania slicing machine comprised of the following step 1) a structure unit of the machine, 2) a motor power unit to rotate sesbania parts, 3) a rubber roller to attach sesbania parts for rotation 4) a knife blade made of steel and driven by an axial jigsaw, 5) a handle unit feeding sesbania that deliver sesbania parts in a guide rail to a knife blade for safety purpose, 6) a handle unit with pick-up hook set used to hold sesbania parts that pushes them toward a knife blade.

1.2. Testing

1.2.1. Analysis procedures of the operation of the sesbania slicing machine can be calculated as follow: Capability of operation of the sesbania slicing machine can be calculated from the equation [3, 4]

$$\text{Work capability} = \frac{\text{Numbers of sesbania parts}}{\text{Time (min)}}, (\text{Part/ minute}) \quad (1)$$

1.2.2. Work efficiency can be calculated from the equation [3, 4]

$$\text{Work efficiency} = \frac{\text{Numbers of the sesbania parts that were sharply sliced}}{\text{Numbers of the sesbania parts that were totally sliced}} \times 100, (\%) \quad (2)$$

1.2.3. Testings to ascertain the distance between a rubber roll and a knife blade that produces a suitable thickness of sesbania sheets were done by using 3 sizes of feeler gauges of; 0.381, 0.457, and 0.508 mm.

2. Results and Discussions

2.1. Study results of physical property of sesbania wood

The study was aimed to determine the length of diameter and thickness of sesbania sheets (as seen in the figure 3) which could be used to design the sesbania slicing machine. For example, the size of a slice groove to hold the stems of sesbania, the length of a knife blade, the size of a core used to pierce sesbania, and distance between a knife blade and a rubber roll for adjusting sliced sesbania sheets that produces the required sizes. Details of the study results are shown in the following table 1.

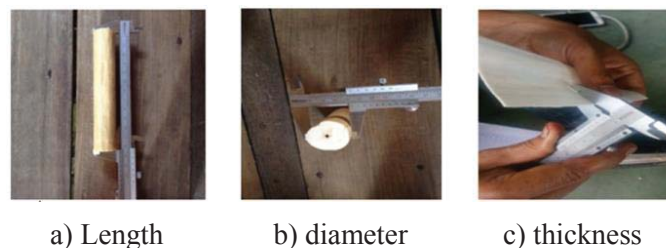
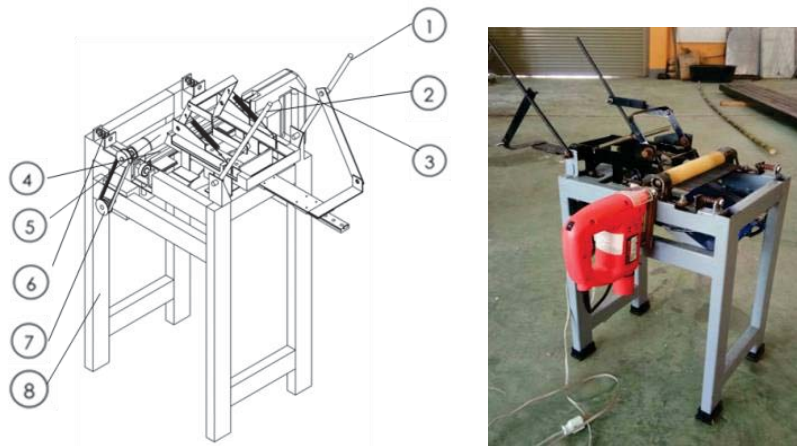


Figure 3. Measurement of physical property of sesbania parts

The results obtained from testing the physical property of sesbania parts before and after slicing was the important fundamental information that was used to design and develop the sesbania slicing machine accordingly.

Table 1. Shows physical property of sesbania parts before and after being sliced.

Sample	The length of sesbania parts	The width of sesbania parts	The thickness of sesbania sheets after being sliced	The length of sesbania sheets after being sliced
Unit in mm.				
1	109.0	32.2	1.2	84.0
2	108.0	31.3	0.9	85.0
3	101.0	30.2	0.9	88.0
4	103.0	30.4	0.9	85.0
5	108.0	28.6	1.2	81.0
6	104.0	29.5	0.6	84.0
7	106.0	32.7	0.8	87.0
8	108.0	28.5	1.0	88.0
9	108.0	26.8	0.8	86.0
10	106.0	27.7	0.8	86.0
Mean	106.0	29.8	0.91	85.0
S.D.	2.64	1.93	0.19	2.12

**Figure 4.** The sesbania slicing machine to produce artificial flowers.**Table 2.** Parts of Sesbania Slicing Machine.

Number	Part
1	Handle-1
2	Handle-2
3	Jigsaw
4	Cutting blade
5	Roller
6	Roller adjustment
7	Motor
8	Machine Metal frame

2.2. The results of designing the sesbania slicing machine to produce artificial flowers

The sesbania slicing machine was designed according to; the rules for calculation and for designing machine elements introduced by Sornil, B. & N ingsanond (1987) [5 - 7], and the fundamental information derived from farmer groups who produce the artificial flowers. The obtained size of sesbania parts was based on the information as seen in the table 2. After that, the sesbania slicing machine is designed and made as seen in the figure 4.

The structure unit, which made of steel tubes, is an important component of the sesbania slicing machine as it supports other parts. The structure unit is 300 mm wide, 400 mm long, and 600 mm high and it is suitable to use in sitting position. The motor power unit works as a source of energy to drive a shaft set for which the capacity of the motor power unit was determined by calculation. Thus, 15 Watt motor has been selected and it can be adjusted revolution from 0-90 revolution (s) per minute which appropriately matches the speed of the rubber roller.

Grooves used to adjust levels are made of 5 mm steel with 40 mm width and 80 mm length, M10 drill size with 60 mm long to move and adjust levels of distance between a rubber roller and a knife blade. This ensures that the thickness of sesbania sheets can be obtained as required. The knife blade unit is designed to be longer than the sesbania parts and driven by an axial jigsaw which is similar to using the manual operation. The lever unit number 1 controls a guide rail to push sesbania parts to the lever unit number 2 that controls the holding of a steel core piercing the middle of a sesbania parts to a knife blade. A spring helps to push the core until the knife blade completely slices the sesbania parts [8 - 9].

2.3. Experimental results

The figure 5 - 7 show experimental results of the developed sesbania slicing machine based on; operational performance, work efficiency, and thickness of sesbania sheets. The experimental results are shown as follow:

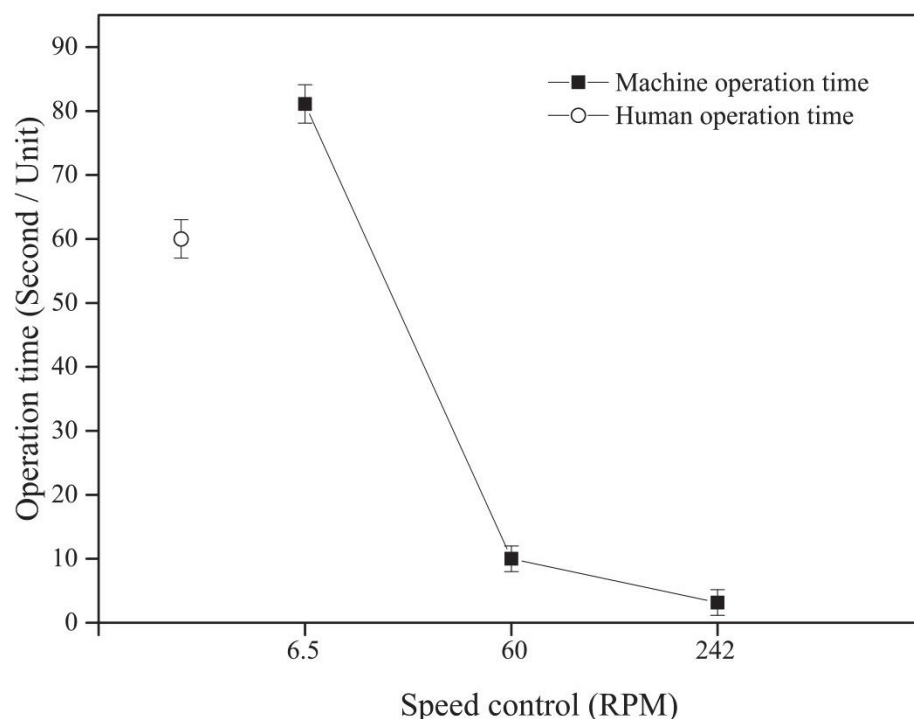


Figure 5. Graph showing relations between revolutions and times used in slicing sesbania parts.

The figure 5 shows the experimental results of the sesbania slicing machine at 6.5, 60, and 242 rpm. According to the results, revolution of the motor controlling the rubber roller that rotate the sesbania parts had effects on working time. Very low revolutions increase working time in slicing sesbania whereas higher revolutions decrease working time in slicing sesbania parts. Based on this experiment, the most suitable revolution was 60 rpm since low revolutions resulted in the wasting of time and, expense. On the other hand, electric power consumption was too high revolutions cause damage to sesbania sheets .

Figure 6 shows efficiency of the sesbania slicing machine at 6.5, 60, and 242 rpm. It was found that efficiency of the machine was at 50, 89 and 20 percent respectively. The highest efficiency ranges was at 60 rpm since sesbania sheets were completed and the obtained size was in accordance with the requirements of the farm women working group.

Figure 7 indicates the experimental results of the sesbania slicing machine that adjusted distance between the rubber roller and knife blade by using 3 sizes of feeler gauge of; 0.381, 0.457, and 0.508 mm. The results revealed that the thickness of sesbania sheets ranged between 0.6, 0.8, and 1 mm respectively. The distance between the rubber roller and knife blade had effect on the thickness of sesbania that were sliced. The suitable distance between the rubber roller and knife blade was associated with the feeler gauge metric of 0.508 mm.

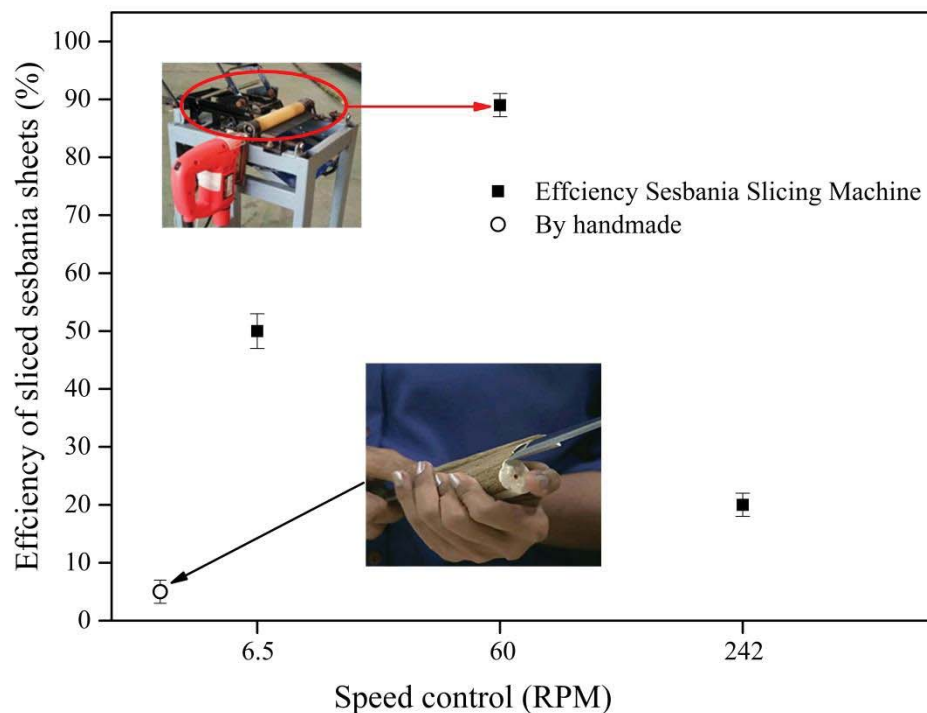


Figure 6. Shows relations between revolutions per minute and efficiency of sliced sesbania sheets.

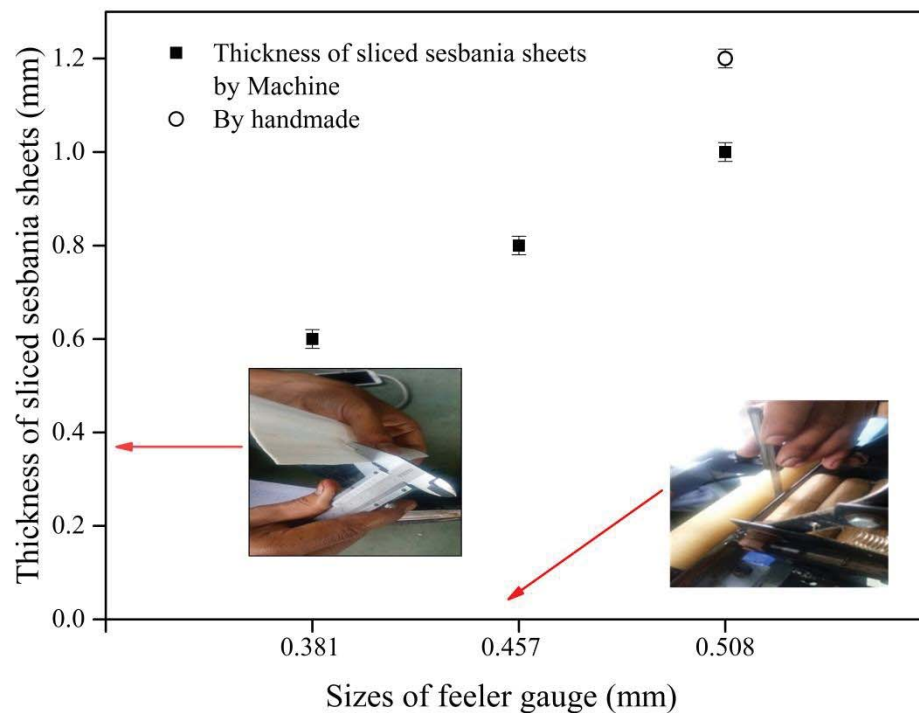


Figure 7. Shows relations between sizes of feeler gauge and the thickness of sliced sesbania sheets.

3. Conclusion

The design and testing of the sesbania slicing machine to produce artificial flowers indicated that, with the suitable revolution per minute, the machine can slice 1 part of sesbania within 10 seconds. Compared to manual slicing, this takes 50 seconds per 1 part and in case of unskillful workers, the working time will be increased even more. The efficiency test results showed that its efficiency was at 89 percent. The experimental test results regarding thickness of sesbania sheets, with adjustment of the distance between the knife blade and rubber roller by using the feeler gauge metric 0.508 mm, indicated that the obtained sesbania sheets were of 1 mm thickness which were suitable and in accordance with the requirements of the farm women working group who makes the artificial flowers. Concurrently, the sesbania slicing machine can reduce accidents that workers may be exposed to manpower.

References

- [1] Karachi M, Lema N, Sabas E and Shirima D 1994 Growth, biomass production and plant mortality of seven *Sesbania sesban* var. *nubica* and three *Sesbania macrantha* accessions at Tumbi, Tanzania *Forest. Ecol. Manag.* **64** 153-9
- [2] Kaspi M and Shabtay D 2001 Optimization of the machining economics problem under the periodic control strategy *Int. J. Prod. Res.* **39** 3889-900
- [3] Gallina P and Trevisani A 2003 On the stabilizing and destabilizing effects of damping in wood cutting machines *International Journal of Machine Tools and Manufacture* **43** 955-64
- [4] Eyma F, Méausoone P-J and Martin P 2004 Strains and cutting forces involved in the solid wood rotating cutting process *Journal of Materials Processing Technology* **148** 220-5
- [5] Sornil B and Ningsanond N 1987 *SI Mechanical Engineering Calculations and System Design* (Bangkok, King Mongkut's Institute of Technology North)

- [6] Wongsaj J, Bhuwakietkumjohn N, Kanlaya T and Chalalai A 2012 Design and Construction of Peeling and Size Reducing Machine for Jackfruit Seed *Agricultural Science Journal* **43** 171-4
- [7] Paraskeva T, Grigoropoulos G and Dimitrakopoulos E 2017 Design and experimental verification of easily constructible bamboo footbridges for rural areas *Engineering Structures* **143**
- [8] Guang-Sheng C and Peng Z 2012 Dynamic wood slice recognition using image blur information *Sensors and Actuators A: Physical* **176** 27-33
- [9] 2017 Ceratizit launches wood machining brand *Metal Powder Report* **72** 374

Acknowledgement

This research has been accomplished with supports from the research scholarship from King Mongkut's University of Technology North Bangkok, for the integrated program of the development of science, technology, research and innovation capabilities, contract number : KMUTNB-61-GOV-02-63.