

Techno-economic Performance of Trimmer of Shallot Dry Leaves

Andasuryani[#], Santosa[#], Hadi Indra Saputra[#], Alhapen Ruslin Chandra^{*}

[#] Agricultural Engineering Dept. Andalas University, Indonesia
E-mail: andasuryani@fateta.unand.ac.id; santosa764@yahoo.co.id; hadi.indrasaputra1290@gmail.com

^{*}Business Administration Dept. Politeknik Negeri Padang, Indonesia
E-mail: alhapen@polinpdg.ac.id

Abstract— While post-harvesting of shallot, the commodity should be released out its dried leaves to make the bulbs became clean prior to be marketed or stored. Post-harvest activities usually did manually using a knife with a working capacity of ± 10 kg / hour per person. In order to improve work capacity, this research conducted to develop a trimmer of dried leaves of shallot bulbs and evaluate the performance of the machine technically and economically. The observation parameter used to evaluate the performance of the machines was trimming output capacity, percentage of trimming, percentage of leaves which were not trimmed, impurities, and loss. Meanwhile, the parameter used for the economic evaluation was cost of trimming. Functionally, the machine that has been developed could trim the dried leaves of shallot with output capacity was 134.38 ± 5.18 kg / hour, trimming percentages was $70.80 \pm 0.81\%$, percentage of leaves which were not trimmed was 19.58% , impurities was 8.10% , and loss was 1.52% . The cost of trimming was IDR 73.47 / kg lower than the cost of manual trimming IDR 500 / kg.

Keywords— dried leaves; output capacity; performance; shallot; trimmer

I. INTRODUCTION

Shallot (*Allium cepa* L.) is one of vegetables rich in nutrients and widely used as a spice of cooking. The crop has a considerable economic potential because the price is relatively high with cultivating a short time period. Shallots can be harvested after a fairly old age which is 60-70 days by showing signs 60% neck soft stems, leaves turn yellow and fall crops [1]. Shallot had much active compounds of antioxidant such as flavonoids and phenolic acids [2], [3], [4]. Its basic nutrients were sugars which could determine properties of sensory and physiological maturity as well as post-harvest durability [5].

One of the areas that produce shallot in Indonesia is West Sumatra. In 2013, production in this area was 42 791 tons, increase 6953 tons (19.40%) from 2012 [6]. Increasing in the number of production was due to increasing harvested area of 474 hectares, or by 12.92% and increasing productivity of 0.56 tonnes / hectare or a total of 5.73%. Although the commodity cultivation had shown an increasing in the number of shallot production, there is less of technology using while handle the post-harvest activity.

Post-harvest handling is very important to keep shallot bulbs clean before marketed or stored to be used as seed. In the post-harvest phase of a shallot, there is an activity of trimming of shallot bulbs dried leaves. This activity is

usually done manually using a knife with a working capacity of ± 10 kg / hour per person. It leads the trimming process will be time consuming and boring if done on a large scale. To cope with this situation, agricultural tools and machines could be used to help alleviate human job including trimming the dried leaves of onion bulbs.

This research was conducted in order to develop a trimming machine of dry leaves of shallot bulbs. In addition it also evaluated the performance of the machine technically and economically.

II. MATERIAL AND METHODS

Trimming machine of dried leaves of onion bulbs (Figure 1) consisted of a hopper, trimming drum, trimmer shaft, trimmer brush, blower, main frame, and a power transmission system. Hopper and trimming drum made from aluminum plate with a thickness of 0.9 mm. Hopper size is 15 cm x 10 cm. Due to the angle of friction of onion bulbs which still have leaves is 45° , hopper mounted on the input hole of trimming drum with a slope angle 45° . Trimming drum has a diameter of 40 cm and a length of 60 cm. There were two trimmer shafts mounted inside the trimming drum. On the shaft trimmer was embedded brush made from nylon strings, arranged with a distance of 2 cm along the axis of trimmer. The length of the brush from the trimmer axis center point was 10 cm. A blower with a diameter of 20 cm

and 7 pieces of fan leaves was used to blow the separated dry leaves from onion bulbs. The source of blower and trimmer shaft driving force came from the same an electric motor. Main frame made from iron elbow (3.5 cm x 3.5 cm) with size of 40 cm x 60 cm x 60 cm (L x W x H). Iron elbow was used since it can withstand the weight of thresher component and material. The trimming machine used a 0.5 Hp electric motor as a driving source. Transmission system of pulleys and belt was used to transfer the power from the electric motor to the trimmer shaft. Rotation speed of the electric motor and the shaft trimmer row was 1400 rpm and 700 rpm respectively. Pulleys diameters of the electric motor and the shaft trimmer row were 3 inches and 6 inches.



Fig 1. Trimmer machine Dried Leaves Onion

The working principle of this machine was the velocity of the two brushes in the opposite direction and provides friction on the shallot which led released the dried leaves from thr shallot bulbs. Furthermore, the cleared leaves shallot will exit through the output door at the bottom of the engine while the dried leaves blown by a blower.

Shallots, used for this study was a local variety of onion Alahan Panjang, harvested by traditional methods. The average moisture content of shallot bulbs and leaves of the shallot bulbs were $80.34\% \pm 0.17\%$ w.b and $40.34\% \pm 0.98\%$ w.b respectively, which is determined by the AOAC method [7]. The speed of shaft rotation of the motor, blower and brush trimmer axis were measured by using a tachometer Krisbow HD 2235B⁺. The noise level of trimming machine dry leaves onion bulbs was measured by using a sound level meter Extech 407736.

Performance testing of the machine consisted of shaft rotation speed of the motor, blower, brush trimmer 1, brush trimmer 2, slip, and the noise level. Other performance technical indicators used were the output capacity, trimming efficiency, percentage of leaves which were not trimmed, impurities, and loss [8]. Performance test of the trimming machine was done for three replications and by analyzed the average value, standard deviation and variance coefficient.

III. RESULT AND DISCUSSION

A. Rotational speed, RPM

The performance test of trimming machine dried leaves of shallot bulbs showed that the rotation speed of the brush shaft 1 and brush shaft 2 (Table 1) in accordance with the plan of RPM which was 700 RPM. The use of belts and pulleys as transmission system caused the slip of $1.61 \pm 0.23\%$. Small contact angle and reduced of friction between the belt and pulleys might cause slip between the belt and pulleys [9].

TABLE I
SPEED ROTATION, RPM

Indicator Performance	Speed Rotation	
	Mean \pm Sd, RPM	Coefficient Varian, %
Shaft Motor Drive	1 420.67 \pm 2.52	0.18
Blower shaft	1 415.67 \pm 4.51	0.32
Brush shaft trimmer 1	704.33 \pm 3.06	0.43
Brush shaft trimmer 2	699.00 \pm 2.65	0.38

B. Noise Level, dB (A)

Noise was the occurrence of unwanted sound that disturbs and endanger the health with the maximum noise level in the workspace is 85 dB (A) [10]. Various factors could determine noise level such as engine type, engine power, design solutions, and job type. Fluctuation of noise level could be identified during a specific type of working process, which could determine by several aspects such as engine loads, rotational speeds, vehicles speeds, weather and soil conditions, and operator's skill (11).

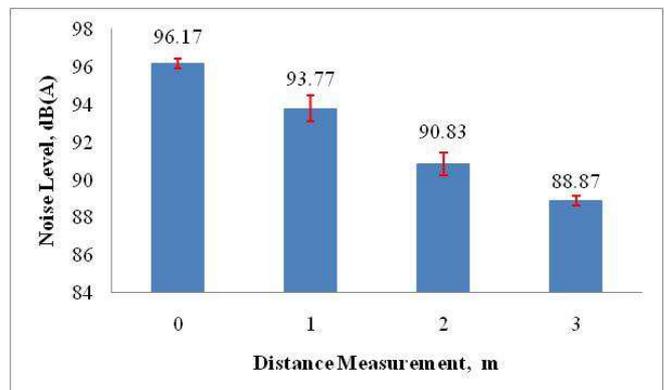


Fig 2. Noise level at several points measurement

Results of noise measurements levels were taken at four points (0 m, 1 m, 2 m and 3 m of the position of the machine in operation) (Fig. 2) showed that the level of noise generated passes through the threshold value of noise (> 85 dB (A)). International Labor Organization (ILO) acknowledged that the value of noise 85 db (A) was an acceptance limit while 90 dB (A), was limit of the dangers of working continuously for 8 hours [12]. The high noise was caused by vibrations generated by the engine components and the sound of the motor. To avoid health problems, operator was advised to use earmuff and ear plugs. While

using earmuff and ear plugs, noise could be reduced by 15 db (A) to 30 db (A) [13].

C. Output capacity (kg / time)

The average output capacity trimmer dried leaves of onion bulbs was 134.38 ± 5.18 kg/h. Capacity values obtained indicate that the machine has been able to increase the capacity become 13 times bigger than manual one (± 10 kg / hr).

D. Percentage of trimming, %

Percentage of trimming on this study consisted of trimming efficiency, percentage of leaves which were not trimmed, impurities, and loss (Fig. 3). Efficiency trimming obtained was $70.80 \pm 0.81\%$. However, this pruning efficiency needed to be improved because there were $19.58 \pm 0.31\%$ shallot bulbs that their dry leaves had not been cut. This was likely due to the nature of the brush trimmer was not rigid which led less friction between the brush with shallots. The machine needed to be repaired, especially on the brush in order to improve trimming efficiency. Meanwhile, the dried leaves and releases outer skin layer of shallots bulb as well as dust and soil were classified as impurities. Dried leaves of shallot bulb (moisture content $40.84 \pm 0.97\%$ w.b) were the largest component of impurities. However, the percentage of shallot bulbs losses was less than 2%.

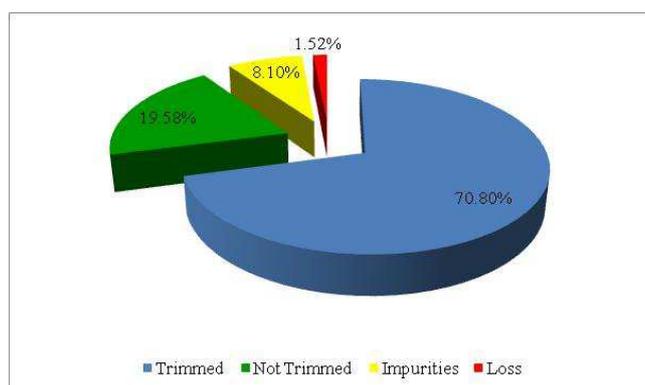


Fig 3. Percentage of trimming

E. Cost of trimming, IDR

Cost of trimming the dried leaves of shallot bulb was IDR 73.47 / kg which were much cheaper than the manual method (IDR 500 / kg). On this analysis, the straight-line method was used in calculating the cost of depreciation with investment interest rate of 12%.

IV. CONCLUSIONS

Trimmer machine dried leaves of shallot bulb have been able to work in accordance with its function. However, increasing the efficiency of pruning needs to be done in order to obtain a better technical performance. One effort that could be done was replacing the brush with a material that more rigid nature.

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