

# The Influence Of Hit Distances And Dimensions Candlenut For Performance Improvement On Breaking Machine Candlenut

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## **Abstract.**

*Candlenut is one of the crops that grow in Indonesia. In Batu Dulang village Batulante sub-district Sumbawa there are candlenut entrepreneurs whose process of breaking candlenut seeds is still manual, person can break 14 – 17 kg/day of candlenut. This reseach was aimed to examine the influence of distance and dimension of candlenut and to increase the performance machines at nutcracker . This reseach was conducted in November to December 2020 at workshop engineering study program, faculty of technique, Sumbawa university. The method used was a case study striking distance (18 mm, 20 mm, 22 mm) small Candlenut dimensions, 18mm to 25 mm, large Candlenut dimension 26 mm to 35 mm, with three levels of treatment and each treatment combination was striking distance of dimensions three time. The parameters of this study ware the percentage of the whole core, percentage of split halves, percentage of core broken and percentage of seeds escaped. The results of this study indicate that the treatment striking distance of dimensions has a significant effect on percentage of crushed core and percentage of seeds escaped. The highest of the intact core wa found at a small Candlenut dimensions striking distance 18 mm 60%, percentage of split halves of 18 mm 20%, percentage of 20 mm 10% core broken and percentage of 22 mm 60% seeds escaped. The highest of the intact core wa found at a larges Candlenut dimensions striking distance 20 mm 53,33% percentage of split halves of 18 mm yaitu 30% percentage of 18 mm 10%,core broken and percentage of 22 mm 60% seeds escaped.*

**Keywords:** *Cundlenut, Hit Distances, Dimensions Candlenut, Performance*

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## **I. INTRODUCTION**

Candlenut seeds are one of the plant products that grow in Indonesia. Candlenut leaves and seeds have many benefits that are useful for human life [1]. Stated that candlenut oil can be used as raw material for making varnishes, paints, soaps, cloth oils, resins, synthetic seeds, lubricants, composts and cleaning or polishing mixtures. Candlenut flesh contains 55% oil which is slightly dark yellow in color and contains toxins so it is not suitable for direct consumption [2].

Candlenut is an abundant crop in Indonesia, so it is very easy to get it in any season. The residents in Batu Dulang Hamlet, Batulanteh District, Sumbawa Besar Regency, West Nusa Tenggara Province earn income from candlenut seeds. In Batu Dulang village, Batulanteh Sumbawa district, there are candlenut entrepreneurs whose process of breaking the candlenut seeds is still manual, one person can break 14-17

kg/day of candlenut and the quality produced is not good because the content of the candlenut produced is destroyed and only a few contents of the candle are still intact which resulted in the selling price of candlenut to decrease. Because the Candlenut seeds are very hard to split, it requires special techniques to keep the Candlenut contents intact. The constraints experienced by candlenut entrepreneurs in Batu Dulang Village are interesting to study because they have a direct relationship with the progress of the times, technology and everything modern, but candlenut entrepreneurs in Batu Dulang Village still use patterns from their ancestors by using simple equipment without the help of machines in carrying out production activities so that it does not rule out the possibility that it can affect the needs of candlenut entrepreneurs on costs in the production process

The development of Science and Technology (IPTEK) encourages humans to create equipment that is more efficient, practical, can help and replace human labor. The agricultural sector is the most important sector in economic development in an area. Therefore, the idea came up to make a tool that can crack the hazelnut shell automatically[3]. Research on candlenut crushing machines has been carried out by many researchers, each of which has different characteristics and purposes. Some are used as a basis to support the implementation of this research. [4] Performed an analysis of the effective capacity of a candlenut crusher with a capacity of 93.6 kg/hour. The data needed is collected by experimental methods through the designed prototype. A total of two crushing shafts that have square pegs will squeeze and crush the hard hazelnut shell [5]. Wrote an analysis of the splitting of the candlenut shell using a ripple mill system with various immersion temperatures. Different pre-processing treatments were carried out before the Candlenut was broken to find out the most effective process before the Candlenut was cracked [6]. Designed a crusher machine with a crash system. The design of the prototype and the realization of the design are carried out to collect data and information. The simple design from construction to breaking mechanism allows this machine to be made on campus production laboratory scale [7]. The results of this study showed that the average diameter of candlenut seeds at intercepts A (length), B (width) and C (thickness) were 32.55 mm, 29.05 mm and 23.23 mm. The average value of roundness and roundness of candlenut seeds is 0.86 and 0.65. At a high level of moisture content, candlenut has a higher compressive strength value and will produce a sticky core on the inner shell. The moisture content of candlenut reaches 4.96% bk after drying in the sun for 20 hours. The maximum strength value at the time of giving the compression test (rupture force) at the water content level at intercept A is 1.208 N, intercept B is 1.198 N and intercept C is 1.950 N.

The design of the candlenut breaker machine which still requires a lot of refinement from the transmission system and hammer breaker with a distance of 18 mm, 23mm, and 28mm, getting pressure at each strike distance of 35.933N, 28.121N

and 23.1N still cannot maximum to produce whole candlenuts regarding the analysis of the work productivity test of the candlenut fruit crusher machine with the impact of the spring force is still not maximal to break the candlenut seeds using only one size of candlenut 3.5 cm 33.47% broken, 58.36% defective, and 8.5% unbroken [8]. Thus, to overcome the problems as described above, in this opportunity, a performance analysis will be carried out on the candlenut crusher, especially the effect of striking distance on the dimensions of the candlenut [9].

The manual process is considered not optimal because it produces little output and has many obstacles. The traditional splitting of the seed coat uses a simple peeler, a rubber bag the size of a Candlenut seed attached to the end of a 30cm to 40cm long wooden or bamboo stalk. The candlenut is then broken by hitting the stone. Standard hoses used are not available and the hoses used are easily damaged by friction or impact. Employees must grab the candlenut and install it on the tool one by one with the end of the candle facing the crushing stone [10]. Then in this opportunity, a performance analysis will be carried out on the candlenut crusher, especially the effect of the striking distance on the candlenut dimensions, because candlenut has different shapes and dimensions as well as surgical hardness, and redesign the candlenut crusher using a V-belt transmission system, pulleys, and a gear box that is connected to a hammer that can be varied in pressure and distance [11]. The hammer is part of the candlenut breaker machine that functions to hit the candlenut, this hammer breaker uses the back force of the spring to get the desired pressure to be able to break the candlenut. This hammer is made of rectangular iron plate arrangement. The design of a machine element must have several aspects that must be considered. Determination of the right material is basically between various properties, environment and ways of use to the extent that the properties of the material can meet some predetermined requirements [12]. Belt transmissions can be divided into three groups namely flat belts, belts with a trapezoidal cross section, and belts with gears. Most belt transmissions use V-belts because of their ease of use and low cost. The disadvantage of the V-belt is that the belt transmission can allow slippage. Therefore, it is necessary to design a V-belt to take into account the type of belt and the length of the belt to be used [13],[14].

The parameters observed in this study were the percentage of intact core, the percentage of split core, the percentage of crushed core and the percentage of seeds that escaped. The intact percentage is the ratio between the weight of the unbroken carner and the total weight of the sample. The percentage of whole seeds can be calculated by the equation of the percentage of halved nuclei using the same formula as the calculation of the percentage of whole kernels. To find the percentage of split nuclei, the ratio between halved nuclei and the total number. The halved core percentage uses the same formula as the intact core percentage calculation. To find the percentage of crushed nuclei, the ratio between crushed nuclei and total candlenuts is

used. The calculation of the pass percentage uses the same formula as the halved core percentage. Calculations to find seeds that pass, the comparison between seeds passes and total candlenuts [15].

## II. METHODS

### *Research variable*

The test analytical method is a procedure that contains clear steps that are systematically arranged in the design procedure. Each stage is a part that determines the next stage so it must be considered carefully. In this study using several variables, namely the independent variable is the distance between the hammer and the wall hit, namely 18 mm, 20 mm and 22 mm with a large candlenut. Small seed size Small candlenut, (18mm to 25 mm) Large candlenut (26mm to 35mm) The dependent variable is Pressure, and the percentage of rupture, Controlled variable is Candlenut seeds that are ready to be broken directly taken from candlenut farmers and machine speed

### *Research Time and Place*

The time required for this research is  $\pm$  2 months (November to December 2020). This research was carried out at the Workshop of the Mechanical Engineering Study Program, Faculty of Engineering, Sumbawa University of Technology

### *Testing and Data Collection Procedures*

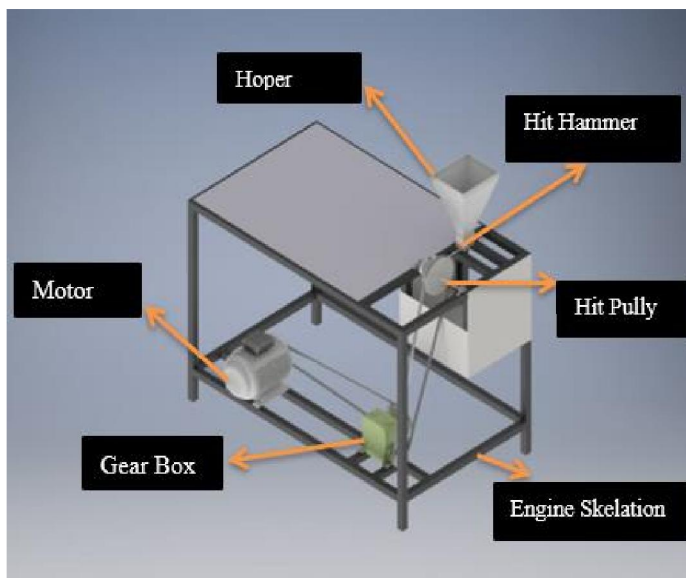
There are two stages of testing the hit distance of the candlenut dimensions in this study, including:

#### A. test preparation

- prepare units of tools and equipment for the candlenut fruit crusher (machine set up)
- preparation of raw materials, namely dried candlenut according to the needs used during the experiment.
- Provide a scale to determine the mass of candlenut
- A container or a place for splitting the candlenut fruit

#### B. test execution

- The first step to take is to operate the candlenut crusher without any load given or previously the Candlenut fruit was inserted into the candlenut crusher room.
- After the first step process, set up the machine. The second step is to measure the striking distance and the dimensions of the candlenut and enter it in the hitting room
- The third step is to calculate the weight of the fruit after going through the splitting process.



**Fig. 1** Machine Breaking Candlenut

**Data Processing Procedure**

In data processing aims to discuss the results of the test and draw conclusions and actual results from an object of research that is in accordance with the wishes and desired goals. In this study, the data processing process was carried out in the following stages:

A. Calculating Force (F)

Force can be described as a push or a pull on an object.

$$F_g = m \cdot g \dots \dots \dots (N)$$

Due to the force that occurs on the spring, Hooke's law applies with the equation.

$$F_x = k \cdot x \dots \dots \dots (N)$$

B. Calculation of Pressure (P)

The hitting chamber is an important part of this candlenut breaking machine which functions as a place where the candlenut is broken by a hammer. The calculation of the pressure on the hammer is calculated by Equation [11].

$$P = F/A \dots \dots \dots (N/m^2)$$

$$P = (k \cdot \Delta x)/A \dots \dots \dots (N/m^2)$$

C. Percentage calculation

The parameters observed in this study were the percentage of intact core, the percentage of split core, the percentage of crushed core and the percentage of escaped seeds. The percentage intact is the ratio between the weight of the unbroken carner and the total weight of the sample. The percentage of whole seeds can be calculated by equation [15].

$$A = \frac{x}{T} \times 100\% = \dots \dots \dots (\%)$$

the percentage of halved nuclei using the same formula as the calculation of the percentage of intact nuclei. To find the percentage of split nuclei, the ratio between halved nuclei and the total number. The percentage of halved nuclei can be calculated by the equation.

$$A = \frac{Y}{T} \times 100\% = \dots\dots\dots(\%)$$

the percentage of halved nuclei using the same formula as the calculation of the percentage of intact nuclei. To find the percentage of crushed nuclei, the ratio between crushed cores and total candlenuts is used. The percentage of crushed nuclei can be calculated by the equation.

$$C = \frac{Z}{T} \times 100\% = \dots\dots\dots(\%)$$

the calculation of the pass percentage uses the same formula as the halved core percentage. Calculations to find seeds that pass, the comparison between seeds passes and total candlenuts. The percentage of seeds that pass can be calculated by equation.

$$D = \frac{P}{T} \times 100\% = \dots\dots\dots(\%)$$

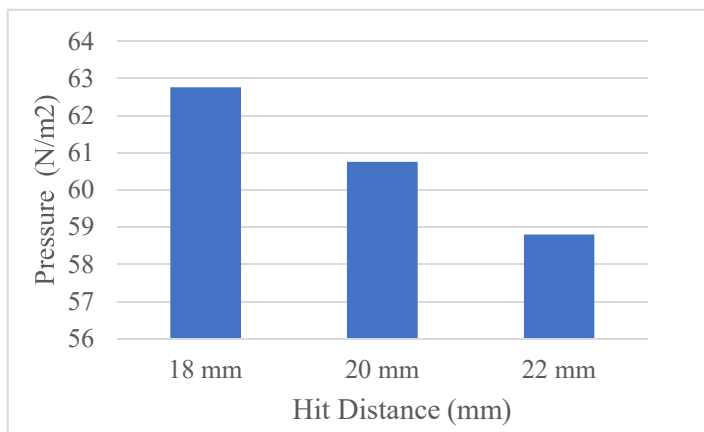
**Results Analysis**

Data analysis is one of the research processes that is carried out after all the data needed to solve the problems under study have been obtained in full. Activities in data analysis are grouping data based on variables, presenting data from each variable studied, performing calculations to answer the formulation of the problem and performing calculations to test hypotheses that have been proposed.

Outline this study aims to determine the results of candlenut fractions with various striking distances, to get the percentage values for intact, split, crushed and unbroken candlenut, by comparing the results of previous studi

**III. RESULT AND DISCUSSION**

**Pressure For Hit Distance**



**Fig. 2** Graph Pressure for Hit Distance

After calculating the pressure at each striking distance, the pressure at a distance of 18 mm is 62.72 N/m<sup>2</sup>, at a distance of 20 mm, the pressure is 60.76 N/m<sup>2</sup> and at a distance of 22 mm, the pressure is 58.8 N. /m<sup>2</sup> . In testing the pressure against this striking distance, the greatest pressure is found at a distance of 18 mm. So it can be concluded that the greater the striking distance, the smaller the resulting pressure due to the comparison between the spring constant, the value of the delta of the spring and the cross-sectional area of the hammer.

***Small Candlenut Cracked Results***

The results of the research on the effect of striking distance on the dimensions of the candlenut, used three variations of the bulk distance of 18mm, 20mm, 22mm and two sizes of candlenut, the small size (18mm to 25mm) while the large candlenut size (26mm to 35mm).

**Table 1.** The average value of small-dimensional candlenut cracking

Hitting Distance	Candlenut Small				
	intack	split half	in	broken	escaped seeds
18 mm	5.66	1.66		0.33	2.33
20 mm	4.66	0.66		0.33	4.66
22 mm	3.66	0		0.33	6

In testing this candlenut breaker machine using alternating spring pressure three times at each striking distance using small candlenut dimensions, getting the average results of small candlenut breaking the graph above shows that at a distance of 18 mm with a pressure of 62.72 N/m<sup>2</sup> there is an average – average split 5.66 intact, 1.66 halved, 0.33 crushed, 2.33 seeds that escaped. At a distance of 20 mm with a pressure of 60.76 N/m<sup>2</sup> there was an average breakdown of 4.66 intact, 0.66 split in half, 0.33 crushed, 4.66 seeds that escaped. At a distance of 22 mm with a pressure of 58.8 N/m<sup>2</sup> there was an average breakdown of 3.66 intact, 0 split in half, 0 crushed, 6 seeds escaped.

***Big Candlenut Cracked Results***

**Table 2.** The average value of broken candlenut large dimensions

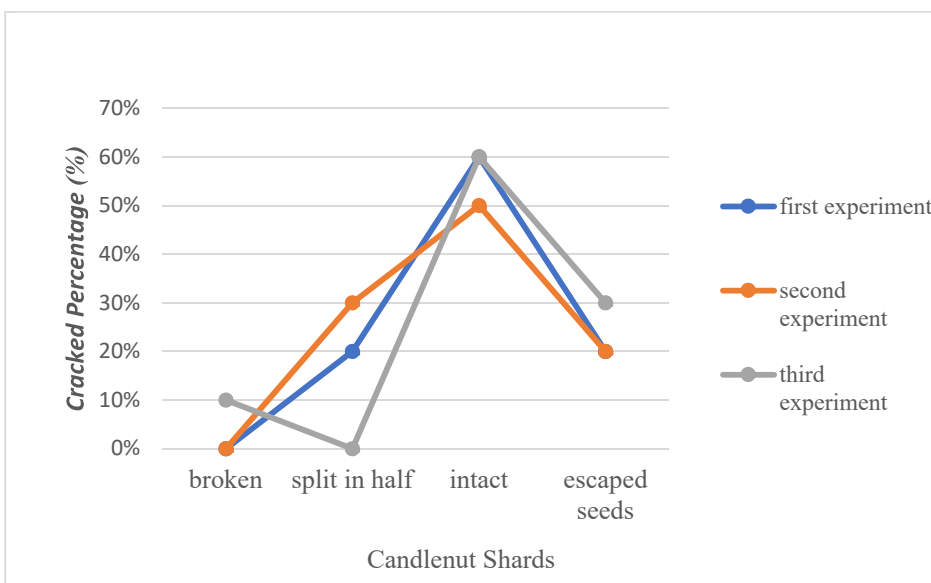
Hitting Distance	Big Candlenut				
	intack	split half	in	broken	escaped seeds
18 mm	2.66	2.33		1	4

20 mm	5.33	1.66	0.33	2.33
22 mm	3.66	1.33	0	5.33

In testing this candlenut breaker using alternating spring pressure three times at each striking distance using large candlestick dimensions, getting results. In the 18 mm distance test with a pressure of 62.72 N/m<sup>2</sup>, the average fracture was 2.66, split in half 2.33, crushed 1, and did not break or passed 4. In the 20 mm distance test with a pressure of 60.76N/m<sup>2</sup> got an average of 5.33 intact, split in half 1.66, destroyed 0.33, and did not break or pass 2.33. In the 22 mm distance test with a pressure of 58.8 N/m<sup>2</sup>, the average fracture was 3.66, split in half 1.33, destroyed 0, and did not break or pass 5.33.

**Small Candlenut Cracked Percentage**

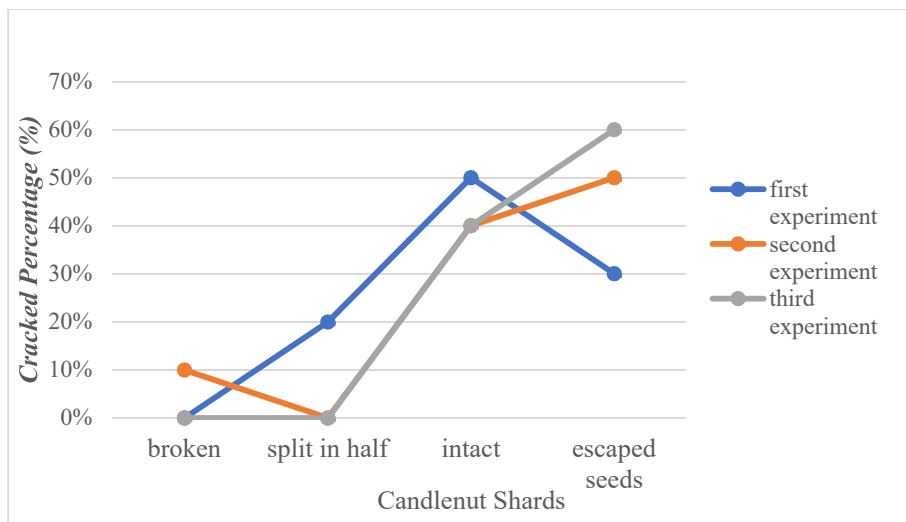
This variation of hit distance to the proportion of small candlenut, it affects the results of the percentage of intact, split, crushed and unbroken at each stroke distance, which was carried out three times at each stroke distance as shown in the graphic image below.



**Fig. 3** Graph of Percentage of Small Candlenut Cracks at 18 mm

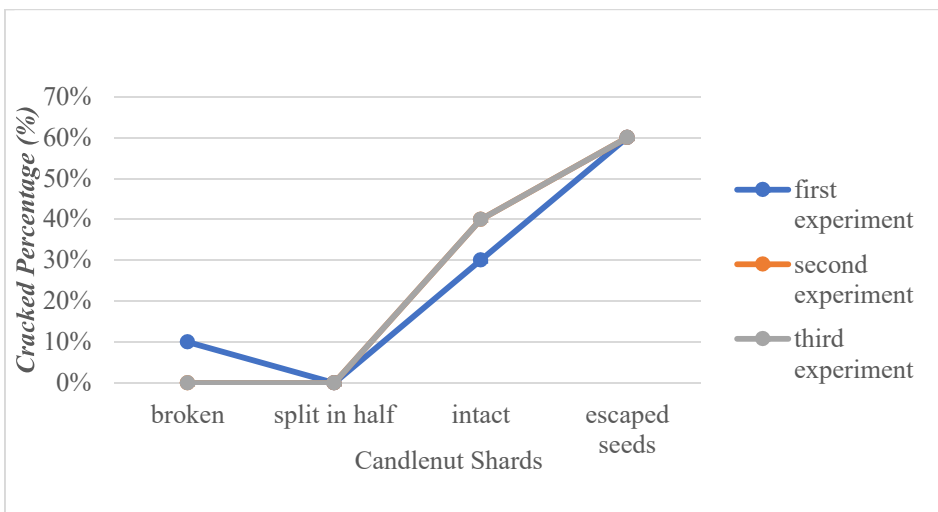
From the results of the graph above that at a distance of 18 mm with a pressure of 62.72 N/m<sup>2</sup> there was a breakdown in the first experiment 60% intact, 20% split in half, 0% crushed, 20% escaped seeds. In the second experiment, the percentage of broken seeds was 50% intact, 30% split in half, 0% crushed, 20% of seeds that escaped. In the third experiment, the percentage of broken seeds was 60% intact, 0% split in half, 10% crushed, 30% seeds that escaped.





**Fig. 4** Graph of Percentage of Small Candlenut Cracks at 20 mm

From the graph above, it can be seen that at a distance of 20 mm with a pressure of 60.76N/m<sup>2</sup> there was a split in the first experiment 50% intact, 20% split in half, 0% crushed, 30% seeds that escaped. In the second experiment, the percentage of broken seeds was 40% intact, 0% split in half, 10% crushed, 50% of seeds that escaped. In the third experiment, the percentage of broken seeds was 40% intact, 0% split in half, 0% crushed, 60% seeds that escaped.



**Fig. 5** Graph of Percentage of Small Candlenut Cracks at 22 mm

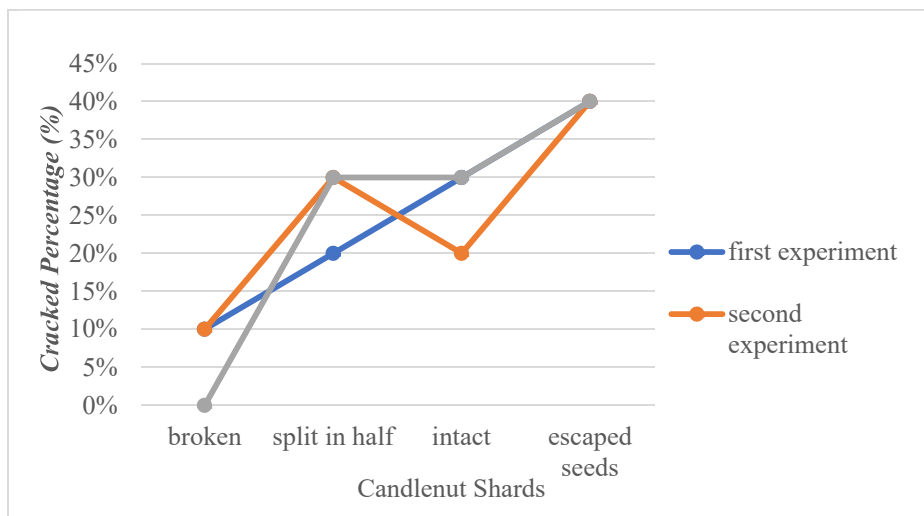
From the results of the graph above, it can be seen that at a distance of 22 mm with a pressure of 58.8 N/m<sup>2</sup> there was a breakdown in the first experiment, 30% intact, 0% split in half, 10% crushed, 60% of seeds that escaped. In the second experiment, the percentage of broken seeds was 40% intact, 0% split in half, 0% crushed, 60% of seeds that escaped. In the third experiment, the percentage of broken

seeds was 40% intact, 0% split in half, 0% crushed, 60% seeds that escaped.

Based on the analysis of the percentage of small candlenuts on variations in the distance and pressure there are Figures 3, 4 and 5 above. The percentage value of whole core from various variations of distance at 18 mm, 20 mm, 22 mm, the highest percentage value of whole core of small candlenut is found at 18 mm distance while the lowest percentage value is found at 22 mm distance treatment. This is influenced by the striking distance and the pressure on the candlestick dimensions (18 mm to 25 mm) at a distance of 18 mm to get a high whole candlenut core caused by the force exerted by the hammer from the hammer hitting the candlenut hitting the wall more maximally then the results of the fraction The small candlenut is getting higher, at a distance of 20 mm the force exerted by the hammer is high enough to break the small candlenut, but the position of the candlenut that causes the candlenut cannot be detected, while at a distance of 22 mm the force exerted is small compared to other striking distances, the magnitude of the striking distance then the force given by the hammer from the hitting hammer is not maximal on the candlenut which collides with the hitting wall and the resulting pressure is getting smaller and the Candlenut is small and getting the force from the hammer as it is on the sheet and there is no collision of the candlenut hitting the hammer and the hitting wall causing the candlenut to not break and many hazelnut seeds escaped.

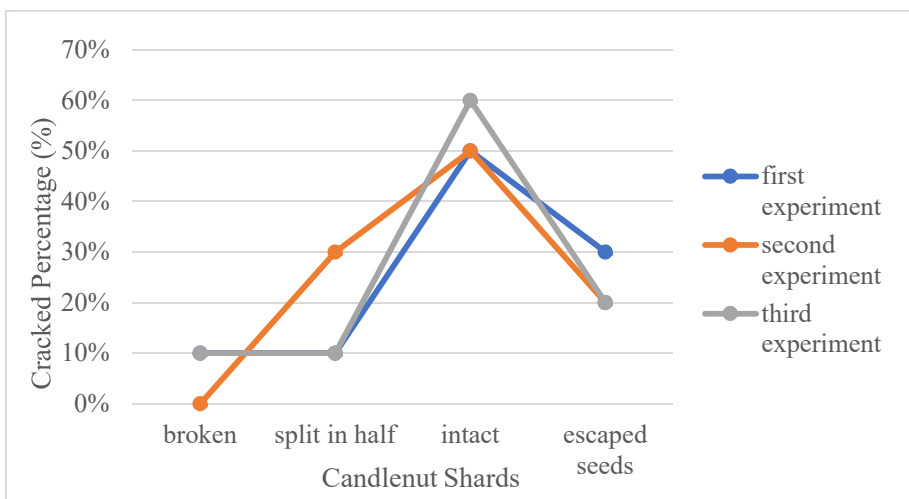
**Large Candlenut Dimension Fracture Percentage Value**

This variation of hit distance to the proportion of large candlenut, it affects the results of the percentage of intact, split, crushed and unbroken at each stroke distance, which was carried out three times at each stroke distance as shown in the graphic image below.



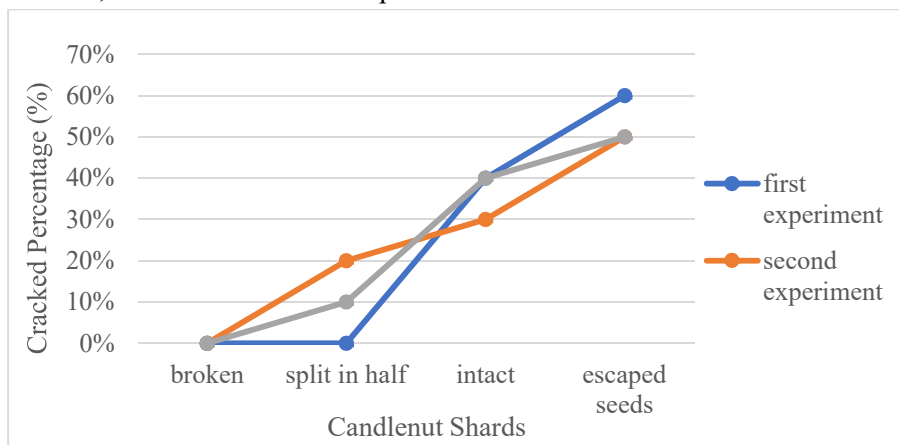
**Fig. 6** Graph of Percentage of Large Candlenut Cracks at 18 mm

From the results of the graph above, it can be seen that at a distance of 18 mm with a pressure of 62.72 N/m<sup>2</sup> there was a breakdown in the first experiment, 30% intact, 20% split in half, 10% crushed, 40% of seeds that escaped. In the second experiment, the percentage of broken seeds was 20% intact, 30% split in half, 10% crushed, 40% of seeds that escaped. In the third experiment, the percentage of broken seeds was 30% intact, 30% split in half, 0% crushed, 40% of seeds that escaped.



**Fig. 7** Graph of Percentage of Large Candlenut Cracks at 20 mm

From the results of the graph above that at a distance of 20 mm with a pressure of 60.76 N/m<sup>2</sup> there was a split in the first experiment 50% intact, 10% split in half, 10% crushed, 30% seeds that escaped. In the second experiment, the percentage of broken seeds was 50% intact, 30% split in half, 0% crushed, 20% of seeds that escaped. In the third experiment, the percentage of broken seeds was 60% intact, 10% split in half, 10% crushed, 20% of seeds that escaped.



**Fig. 8** Graph of Percentage of Large Candlenut Cracks at 22 mm

From the results of the graph above that at a distance of 18 mm with a pressure of 58.8 N/m<sup>2</sup> there was a breakdown in the first experiment 40% intact, 0% split in half, 0% crushed, 60% seeds that escaped. In the second experiment, the percentage of broken seeds was 30% intact, 20% split in half, 0% crushed, 50% of seeds that escaped. In the third experiment, the percentage of broken seeds was 40% intact, 10% split in half, 0% crushed, 50% of seeds that escaped. Based on the analysis of the large candlenut percentage of the variation in the distance and pressure there are Figures 6, 7 and 8 above. The percentage value of intact core from various variations of distance at 18 mm, 20 mm, 22 mm, the percentage value of the whole core of large candlenut is at a distance of 20 mm, which is 60%, while the lowest percentage value is found in the treatment at 18 mm distance of 30%.

This is influenced by the striking distance and pressure on the dimensions of the large candlenut (26 mm to 30 mm) at a distance of 20 mm the force exerted by the hammer is high enough to break the large candlenut causing the candlenut to break completely and split in half better than at a distance of 18 mm and 22 mm. While at a distance of 22 mm the force applied is small compared to other striking distances, the magnitude of the striking distance means that the force given by the hammer from the hammer hits is not maximal on the candlenut which collides with the hitting wall and the resulting pressure is smaller and the Candlenut is large and gets the force from the hammer like in a sheet and there was no collision of candlenut, the hammer and the hammer caused the candlenut to not break and many of the candlenut seeds escaped.

#### **IV. CONCLUSION**

From the results of the research conducted, it can be concluded as follows: The right time to solve the dimensions of the small candlenut is at a distance of 18 mm to get 6 whole pieces, 2 pieces split in half, and 2 pieces don't break. The correct strike distance to solve the dimensions of the large candlenut is a distance of 20 mm to get 6 whole pieces, 1 piece split in half, 1 piece crushed, and 2 pieces not broken. The percentage of small candlenut shards produces the highest percentage of distance at 18 mm, which is 60% due to the force exerted by the hammer from the hammer hitting the candlenut hitting the wall more maximally, the higher the result of small candlenut shard While the percentage of large candlenut shards produces the highest percentage at a distance of 20 mm, which is 60%.

The influence of the candlenut dimensions on the striking distance of this tool has a significant effect on the candlenut fractions produced, while at 22 mm in each dimension of the candle, many seeds pass.

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