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Performance Test of Cassava Cutting Machine Type of Double Block Cutter

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ABSTRACT

Preparation of cassava seeds using a machete or hand saw takes a long time, the results are not uniform, and there is a potential for damage to cassava seedlings. The double block cutter type cassava stem cutting machine has been designed to produce high capacity and good quality cassava seeds. This study aims to test the performance of the cassava stem cutting machine with the double block cutter type. Performance tests include measuring machine working capacity, fuel consumption, seed uniformity, and planting test. The cutting test was carried out using 3 varieties of cassava seedlings. The machine works at a rotational speed of 3800 rpm and the test was carried out with various feeding loads, namely 3 rods, 4 rods, and 5 rods with. Each test was repeated 3 times. Cassava stem cutting machine (Petokong) is suitable for producing cassava stems with an average working capacity of 16275 seeds/hour. The results of the Anova test showed that the number of baits and varieties of cassava seeds and their interaction had a significant effect on the working capacity of the Petokong machine. Variations in fuel consumption are thought to be influenced by the variety of cassava stem used, which is influenced by the stem diameter of each variety. The Petokong machine is far superior to manual cutting using a machete or saw which can only produce 815 and 3005 seeds/hour per hour. The average fuel consumption is 1.82 liters per hour. Seed uniformity is about 98% and seedling damage can be minimized to 2%. The seeds produced by the Petokong machine can grow well, which is indicated by the appearance of shoots and an even distribution of roots.

1. INTRODUCTION

Cassava is the basic ingredient for making tapioca flour (Wei et al., 2018), bioethanol, mocaf, and various other derivative products. Cassava production in Lampung Province continues to increase (Hasanudin *et al*., 2019; Widayat *et al*., 2019). BPS (2017) noted that

cassava production in Lampung Province reached 7.4 million tons in 2015. This increase in production resulted in an increase in the need for cassava stem seedlings.

Cassava seedlings are produced from stems by cutting 10% of the stem (Amien *et al*., 2021). Preparation of cassava seeds is done using a machete or saw. Efforts to provide seeds in this way take a long time, the capacity is low, the seeds are not uniform and result in splitting of the base which causes the roots to grow imperfectly. According to Kurniawan (2019), the capacity of using a machete is only 810 seeds/hour and 3000 seeds/hour using a saw. This amount is not sufficient for planting seedlings per area planted where the average seed requirement is 15,000 seedlings/ha. To meet the availability of high, fast, and quality cassava seeds, a cassava stem cutting machine is needed.

Cassava stem cutting machine designed to meet this need is a double block cutter type cassava stem cutting machine. This machine is designed with a high working capacity with the ability to produce seeds of uniform size, high growth power and affordable prices. The double block cutter type cassava stem cutting machine needs to be tested and perfected for its performance so that it can meet these needs. This study aims to provide cassava seeds with a high capacity cassava seed cutting machine (Petokong) with uniform seedling size, and high growth power.

2. MATERIALS AND METHODS

The tools used in this study were cassava seed cutting machine (Petokong) double block cutter (Figure 1), 500 ml measuring cup, digital laser tachometer, machete, saw, meter, and stopwatch. The materials used for testing the engine were cassava stems of UJ-3 variety (Thailand), Genjah Manggu variety, UJ-5 variety (Cassesart), and gasoline.

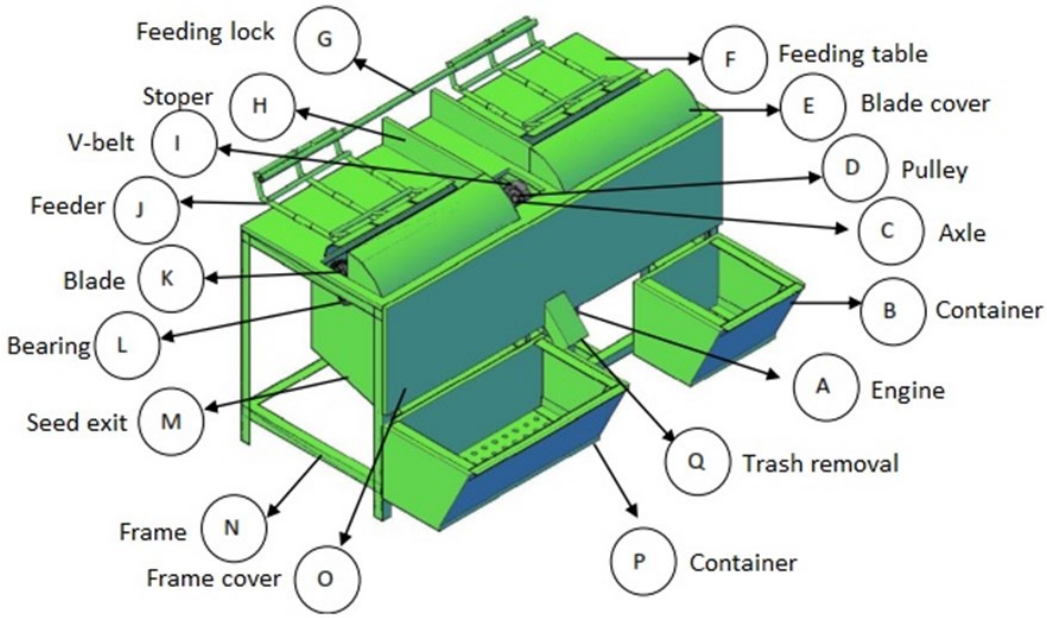

Figure 1. Cassava seed cutting machine (PETOKONG) double block cutter type

Cassava Seed Cutting Machine (Petokong) with dimensions of 166 cm long, 70 cm wide, and 90 cm high engine has main components in the form of a driving motor, cutter, transmission system, frame, and thruster with the specifications shown in Table 1. The driving motor used gasoline-powered with a power of 10 HP.

Table 1. Petokong machine specifications

Component	Part	Note	
Engine	Gasoline motor	Trade mark	: Ikeda
		Power	: 10 HP
		Number of cylinder	: 1
Cutter	Block cutter 1 & 2	Wide	: 25 cm
		Length	: 80 cm
		High	: 12,5 cm
	Cutter blade	Number	: 8
		Material	: stainless steel
		Number of blade	: 44
Transmission	Top pulley	Size	: 3 inch
		Hole diameter	: 1 inch
		Number of pulley	: 2
	Bottom pulley	Size	: 4 inch
		Hole diameter	: 1 inch
		Number of pulley	: 2 buah
	V-Belt	Tipe	: A
		Size	: 61 inch
Frame	Machine frame	Size	: 160*70*90 cm
		Material	: Iron, L 4*4
Pusher	Pusher rail	Material	: plain iron rod 16
		Number	: 2

2.1. Research procedure

The main stages carried out in this study were the preparation of tools and materials used, setting the Petokong machine, cutting cassava stems with the Petokong machine and cutting cassava stems, measuring machine capacity, fuel consumption, and uniformity of the seeds produced, and finally doing a planting test. the resulting seeds.

The research began by preparing the equipment and materials to be used, including a cassava stem cutting machine (Petokong) double block cutter type and other supporting equipment. The material tested was cassava stems with a length of 1.5 m. After all the tools and materials have been collected, adjustments are made to the Petokong machine in the form of setting the RPM (3800 rpm).

Data processing was carried out using a completely randomized design (CRD) with a factor of 1, namely the number of stem baits with 3 treatment levels, namely treatment 3 (B1), 4 (B2), and 5 (B3) cassava stem bait. Factor 2 is cassava stem varieties, including the UJ-3 (V1) variety, the Genjah Manggu variety (V2), and the UJ-5 (V3) variety. The combination of treatments between the number of cassava stems and varieties was repeated 3 times with the combination of treatments as the following:

B1V1 : feeding 3 stalks of cassava variety UJ-3 (Ø 1-2 cm)
B2V1 : feeding 4 stalks of cassava variety UJ-3 (Ø 1-2 cm)
B3V1 : feeding 5 stalks of cassava variety UJ-3 (Ø 1-2 cm)

B1V2 : feeding 3 stalks of cassava variety Genjah Manggu (Ø 2.1-2.5 cm)
B2V2 : feeding 4 stalks of cassava variety Genjah Manggu (Ø 2.1-2.5 cm)
B3V2 : feeding 5 stalks of cassava variety Genjah Manggu (Ø 2.1-2.5 cm)
B1V3 : feeding 3 stalks of cassava variety UJ-5 (Ø 3-3.5 cm)
B2V3 : feeding 4 stalks of cassava variety UJ-5 (Ø 3-3.5 cm)
B3V3 : feeding 5 stalks of cassava variety UJ-5 (Ø 3-3.5 cm)

2.2. Observation

Parameters observed from this study include the working capacity of the tool, the use of fuel, uniformity of seedling size and degree of damage, as well as seedling growth in the field.

1. Machine working capacity

The working capacity of the machine is calculated based on the amount of material produced in the time interval used (Yusuf *et al*., 2020). The working capacity of the Petokong machine is obtained based on the number of pieces of seed divided by the time used. The equation for calculating the working capacity of the machine is calculated using the equation:

$$KK = \frac{n}{t} \quad (1)$$

KK is the machine's working capacity (seed/hour), *n* is the number of cutting seedlings, and *t* is time (hours).

2. Fuel consumption

The use of fuel is the consumption of fuel per unit of time (Nugeraheni and Pratama, 2018). Before use, the fuel in the tank is fully filled (full tank). After the test, the fuel in the tank is refilled to the brim using a measuring cup. The volume of fuel that is filled back into the tank is the volume of fuel used. Fuel consumption is calculated using the equation:

$$BB = \frac{Fv}{t} \quad (2)$$

where *BB* is the use of fuel (l/hour), and *Fv* is the volume of fuel used (l).

3. Uniformity of seedling size and damage rate

The calculation of the percentage of machine cut results is determined with the following conditions:

a. Calculating the percentage of the length of the cut seedlings that were cut using a Petokong machine with a seed length of 20 cm.
b. Calculating the percentage of uniformity of cuttings and the damage of cut cassava seedlings. Seedling damage is characterized by uneven and broken cut surfaces.

4. Test the initial planting of seedlings in the field

This observation was carried out by observing the number of seedlings that grew and those that did not. Observations were made after the seeds were planted for 30 days.

3. RESULTS AND DISCUSSION

3.1. Machine Working Capacity

The working capacity of the machine is obtained based on the number of pieces of each treatment against the time of data collection. The data showed that the cassava stem cutting machine with the double block cutter type had a different working capacity for each treatment as presented in Figure 2. Cassava stems with the UJ-3 variety produced the highest number of seeds for each feed (3 stalks, 4 stalks, and 5 stalks). This is because the diameter of the UJ-3 variety is smaller than the Genjah Manggu and UJ-5 varieties. UJ-3 cassava seeds produced per hour were 15,608 seeds, 17,521 seeds, and 15,696 for feeding 3, 4 and 5 stalks, respectively. The average working capacity of the machine per hour is 16,275 seeds/hour. Cassava stems with stem diameter of 3-3.5 cm (variety UJ-5) produced smaller seedlings than varieties UJ-3 and Genjah Manggu (Figure 2).

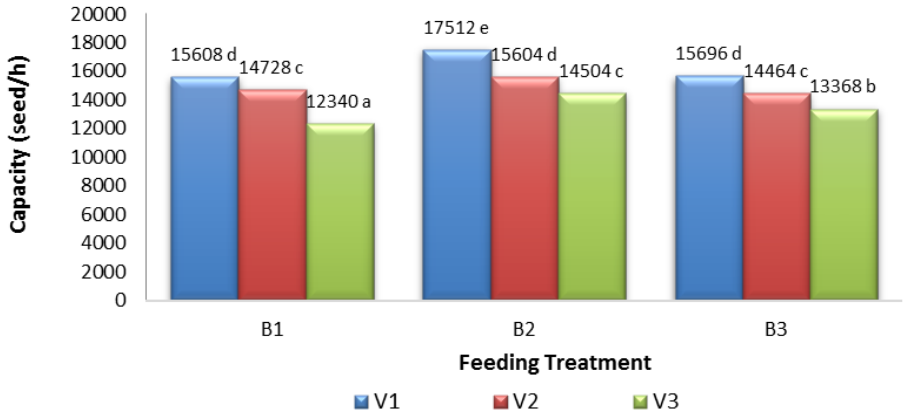

Figure 2. Graph of the working capacity of the cassava stem cutting machine with double block cutter type

The results of the ANOVA test showed that the number of feed factors and the cassava seed variety factor and their interaction had a significant effect on the working capacity of the Petokong machine. This is shown in Figure 2 where the largest working capacity is produced by the interaction of factor 1, namely the treatment of the number of feeds of 4 cassava stalks and factor 2, namely the UJ-3 variety with the smallest diameter of other varieties (1-2cm).

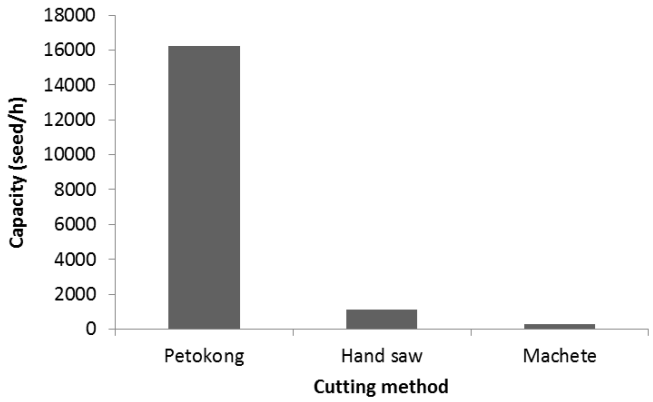

Figure 3. Performance comparison of several types of cassava stem cutter

The cassava stem cutter double block cutter (Petokong) has a working capacity that far exceeds that of saws and machetes as shown in Figure 3; where the saw produced 1120 seeds/hour, machete 285 seeds/hour, while Petokong produced 16,275 seeds/ hour.

3.2. Fuel Consumption

Fuel consumption is a measure of the fuel consumed by the engine to produce power (Esaputra *et al.*, 2016). Fuel consumption in this study was measured based on the amount of fuel consumption per 1000 seeds produced. Figure 4 shows that the Petokong engine uses different amounts of fuel in each treatment. The trend in the three treatments shows fuel consumption with the same trend. The larger the diameter of the rod, the higher the fuel consumption. To determine the effect between the two factors, the ANOVA test was carried out with a factor of 1 number of feeds and a factor of 2 types of varieties (Table 2).

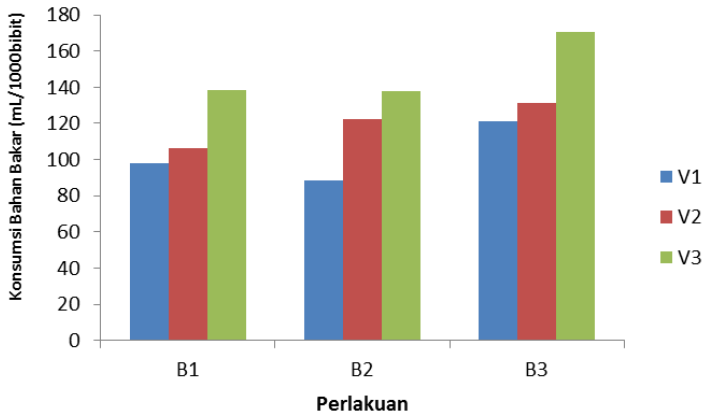

Figure 4. Fuel consumption of cassava stem cutter double block cutter

Table 2. ANOVA test of the effect of the number of feeds and types of varieties on fuel consumption

Source	DF	Type ISS	Mean Square	F Value	Pr > F
Model	8	14642,14	1830,27	26,51	<.0001
Factor 1 (Feeding)	2	3879,16	1939,58	28,09	<.0001
Faktor 2 (Variety)	2	10055,91	5027,95	72,83	<.0001
Interaaction	4	707,07	176,77	2,56	0,0740
Error	18	1242,69	69,04		
Corrected Total	26	15884,83			

Based on the Anova test in Table 2, the number of feed factors and cassava varieties have a significant effect on fuel consumption, but there is no interaction between the two factors. to see further the influence of each factor, then proceed with the BNT test at the level of 5%.

Table 3. BNT test of the number of feeds and cassava varieties on fuel use (mL/1000 seeds)

Feeding amount	Cassava Variety			Average
	V1	V2	V3	
B1	98,22	107,15	138,57	114.65 b
B2	88,85	122,74	139,75	117.12 b
B3	121,40	131,66	170,59	141.22 a
Average	102.83 c	120.52 b	149.64 a	

Based on the BNT test (Table 3), the use of bait in the treatment of B1 (3 baits) and B2 (4 baits) was not significantly different from fuel consumption, but B3 had an effect on increasing fuel consumption. V1 (variety UJ-3) with stem diameter of 1-2 cm was smaller than V2 (variety of Genjah Manggu) with stem diameter of 2.1-2.5 cm. Varieties V2 were smaller than V1 (variety UJ-5) with a stem diameter of 3-3.5 cm. The difference in fuel consumption is thought to be influenced by the variety of cassava stem used which is influenced by the stem diameter of each variety.

3.3. Percentage of Seed Size Uniformity

Cutting cassava seedlings with a Petokong machine produces a more uniform seed size. Petokong produced a high percentage of seed uniformity reaching 98% (Table 4) with a seedling size of 20 cm. Generally, the length of the stem used as seed is 25 cm. However, based on research conducted by Nahar & Tan (2012), the length of the seed pieces did not affect the production of tubers produced. The use of seedlings with a length of 15-20 cm is considered effective and does not affect plant growth (Remison *et al*., 2015).

Table 4. Comparison of the percentage uniformity of cassava seeds

Cutting method	Seed production (seed/h)	Uniform seed (seed)	Persentage (%)
Petokong machine	16,275	15,949	98
Hand saw	3005	2735	91
Machete	815	326	40

Figure 5. Cassava seed cuts using (a) Petokong, (b) Hand saw, and (c) Machete

Figure 5 shows the cutting results of the three types of cutters. Shown in Figures 5 a and b produce a flat cut surface. This is because the type of blade used is relatively the

same, where the Petokong blade is in the form of a saw with 44 blades. The interaction between factor 1 (amount of feed) and factor 2 (type of variety) did not significantly affect the uniformity of cassava seed size. So that these two factors do not affect the uniformity of the size of the seeds produced.

3.4. Percentage of Seed Damage Rate

The damage that generally occurs in cutting cassava stem seedlings can be seen in Figure 6. The cutting knife and cutting mechanism are important elements that determine the resulting seed pieces (Jyoti *et al*., 2018).

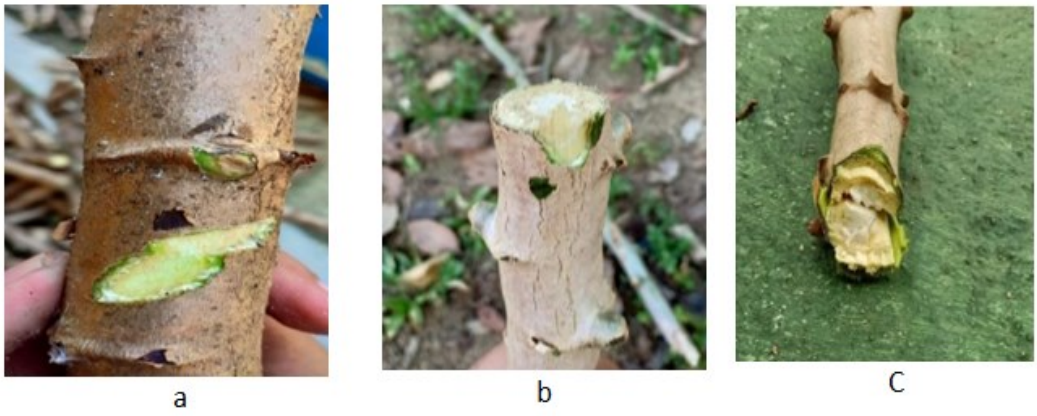

Figure 6. Cutting damage using (a) Petokong, (b) Saws, and (c) Machetes

The highest level of damage was produced by cutting seedlings using a machete with a percentage of 45%. The damage is thought to have occurred due to the sharpness of the blade on the machete and the diameter of the stem. The larger the diameter of the stem being cut, the more difficult it will be to cut it. The next highest level of damage is the chainsaw at 15%. The damage is thought to have been caused by blunt saw blades and slippage due to the cutting process which caused a lot of scratching of the epidermis of the cassava stems. Meanwhile, the damage to Petokong yields (as much as 2% of the total seedling cut) was thought to be caused by an error during the stem insertion process, resulting in scratches on the cassava stems.

3.5. Seed Growth Test

The cassava seedling growth test was carried out to determine the growth power of the seeds produced from the cutting process and to determine the growth and distribution of roots in the planted seeds. The percentage growth of cassava stem seedlings is shown in Table 5. Based on the 25 number of seedlings planted, the highest percentage was produced by seeds that were cut with Petokong at 100%. This means that all seeds can grow well which is marked by the emergence of shoots on the stem.

One that affects plant growth and production is seeds with the best quality because it will affect the roots of cassava plants (Legese *et al*., 2011; Amarullah *et al*., 2016). Figure 7 shows root growth in seedlings cut using a petokong machine, saw and machete.

Table 5. Percentage of seedlings growing on different types of cutters

Cutting methods	Number of planted seed	Number of growing seed	Success persentage (%)
Petokong machine	25	25	100
Hand saw	25	24	96
Machete	25	22	88

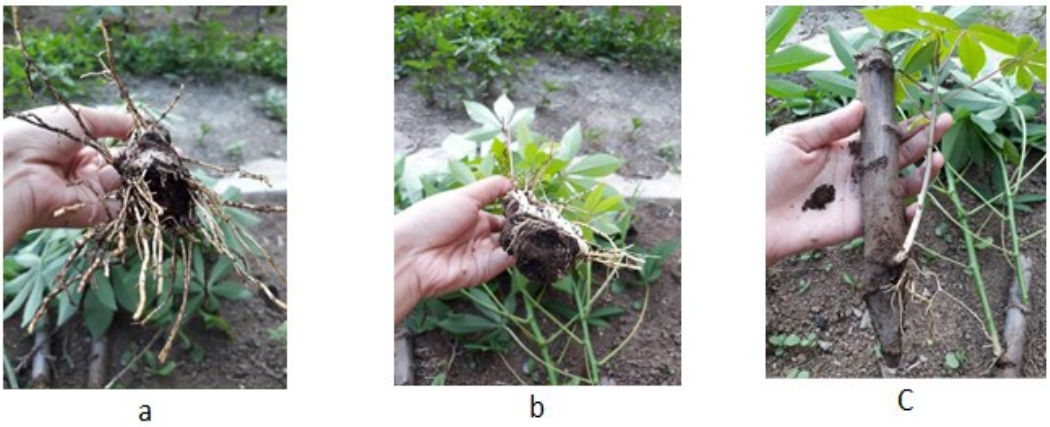

Figure 7. Root growth of cassava seedlings from different cutting methods: (a) Petokong, (b) Hand saw, and (c) Machete

Figure 7a shows the perfect root growth produced from seedlings cut using the Petokong machine. The growth of this root is much different from that of seedlings cut with hand saw (Figure 7b) and machetes (Figure 7c) where the spread of roots only accumulates in one part. The flat surface of the seeds as resulted by cutting using the Petokong machine affects the growth of cassava roots because it minimizes seedling damage (broken) so that the roots can spread well. The roots that spread on the surface of the cut are called adventitious roots. Adventitious roots are the core of tuber formation (Pardales *et al.*, 1999). The new roots look white and brittle, but as they grow these roots will harden which then some roots will experience thickening so that they develop into tubers (Siswati *et al.*, 2019).

4. CONCLUSION

Cassava stem cutting machine (Petokong) is suitable for producing cassava stems with an average working capacity of 16,275 seeds/hour. The results of the Anova test showed that the number of baits and varieties of cassava seeds and their interaction had a significant effect on the working capacity of the Petokong machine. Variations in fuel consumption are influenced by the variety of cassava stems used because varieties have different stem diameters. The Petokong machine is far superior to manual cutting using a machete or saw which can only produce 815 and 3005 seeds/hour per hour. The average fuel consumption is 1.82 liters per hour. Seedling uniformity is about 98%. Seedling damage can be minimized up to 2%. The seeds produced by the Petokong machine can grow well, which is indicated by the appearance of shoots and an even distribution of roots.

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