

Cassava Plant Soil Processing Machine

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ABSTRACT

The cassava tillage machine has a construction design for the frame, plowshares and wheels. In the frame design, the dimensions are ± 1.5 meters long, ± 1 meter wide and $\pm \frac{1}{2}$ meter high. For the plowshare design, there is a plowshare size, namely a height of 40 cm, a plowshare width of 38 cm and an angle of $\pm 35^\circ$. And the wheels are made from 16 ring rims with additional outer fins on 40 x 40 mm steel angled profile rims with a thickness of 2 mm. This machine uses a transmission system, namely two transmissions including (pulley with V-belt) and (sprocket with chain) on two shafts that connect each other to rotate the shaft so that the wheels rotate. This machine's transmission uses a type B small pulley with a diameter of 72 mm, a type B large pulley with a diameter of 203.2 mm, a small 420 gear with 14 teeth, and a large 420 gear with 42 teeth. For the V belt, type A belt is available with size 51 inches.

INTRODUCTION

Along with the rapid progress of technology, especially in the field of basic machinery, the industrial world is experiencing very dynamic changes. Increasingly sophisticated machining technology demands the use of production machines that are not only efficient, but also creative and capable of meeting increasingly complex and diverse operational needs (Anggara, 2023; Jasadila, 2017). These needs cover various sectors, from manufacturing to agriculture, each of which has its own challenges and needs. To face these challenges, innovative thinking is needed, where creative ideas can produce solutions that are effective and relevant to conditions in the field (Susilowati et al., 2024).

In the agricultural context, one of the problems that is still a major obstacle is the use of traditional tools in cultivating the land (Aldillah, 2016; Pranadji & Budianti, 2016). Farming communities in many areas still rely on manual methods such as using hoes and other simple tools. This method, although used for many years, has significant limitations. Using a hoe, for example, requires a lot of physical effort, takes a long time, and is inefficient for large areas of land. This of course has an impact on agricultural productivity that is not optimal, as well as limiting farmers' ability to increase their crop yields.

On the other hand, although more modern tillage equipment is available on the market, the price is often a major barrier for many farmers, especially those from the lower to middle economic groups (Pujiriyani, 2022). The high price of equipment makes it unaffordable for most farmers, so they are forced to continue using traditional methods. This condition creates a gap in the agricultural sector, where only a handful of farmers are able to enjoy the benefits of modern technology, while others are left behind and continue to struggle with existing limitations.

Responding to this problem, we have a strong commitment to providing real and beneficial solutions for the community, especially farmers. We realize that to help society overcome this challenge, innovation is needed in the form of agricultural land processing machines that are not only designed with modern technology, but also prioritize aspects of practicality and affordability. We strive to create machines that can be operated easily by anyone, without requiring high technical skills, so that they can be accessed by all levels of society (Ajib & Habiburrahman Aksa, 2023; Waspiyah et al., 2022).

More than that, we also hope that this machine will not only be a temporary solution, but can also become a tool that can be used sustainably by the community. We want these machines to become an integral part of everyday farming processes, helping farmers increase their productivity, and ultimately, improve their welfare. With this machine, we believe that agriculture in Indonesia can develop more rapidly, with more abundant and quality results. It is hoped that this innovation can open up new opportunities for farmers to be more competitive, both at the local and global level, as well as creating a sustainable positive impact on the community's economy as a whole.

THEORETICAL FRAMEWORK

A. Machine Working Principles

This soil processing machine for cassava plants is designed to use two interconnected transmission systems to produce the rotation needed for the machine wheels to move. The first transmission, which consists of a pulley, v-belt, and shaft I, works together with the second transmission, which uses a sprocket and shaft II. Both work synergistically to move the wheel. Apart from that, this machine is equipped with a plow share which functions to cultivate or loosen the soil during operation.

When the engine is started, the engine rotation is not directly transmitted to the first transmission because the v-belt is still loose. To start transferring rotation, the v-belt must be tightened first. This process is carried out by pulling the v-belt tensioning lever located on the machine's steering wheel, so that the v-belt can bite the pulley firmly. After the v-belt is securely attached to the pulley, rotation from the engine can be transmitted through the first transmission to the second transmission. The rotation produced by this second transmission is then transmitted to the tractor wheels, allowing the wheels to rotate.

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B. Driving Machine

The driving machine is a very important and fundamental element in the entire machining process, especially in matters related to the development of mechanical forces. This machine acts as the main source of energy needed to move various components which were initially in a stationary or static state. Without the presence of a driving engine, these components will not be able to do their job properly, so that the entire machinery system will experience problems or even not be able to function at all (Rivki et al., n.d.).

The main function of a driving engine is to convert energy – be it electrical energy, fuel energy, or other forms of energy – into mechanical

force. This mechanical force is then used to create movement in stationary machine parts. When the drive engine is activated, it channels energy through various mechanisms specifically designed to move certain components according to system needs (Dr. Ramadoni Syahputra, 2020). As a result, previously immobile components begin to operate, carrying out their functions with precision and efficiency.

As the core of a machinery system, a driving machine not only initiates movement but also maintains smooth operation throughout the process. This machine ensures that each component can move in perfect synchronization with the others, thereby creating harmony in the entire mechanical process. Without a reliable driving engine, other components will not be able to carry out their specified tasks, which can result in malfunction of the system as a whole.

Therefore, the existence of a driving machine cannot be ignored in every machining application. It is the main driving force that ensures that the entire production process or mechanical operation can take place efficiently, effectively and in accordance with the desired goals. The reliability and performance of the driving machine greatly determines the success of the overall machining process, because it allows the machine components to function properly, carrying out their respective roles in a complex series of operations.

METHODS

This research is experimental research, which is a type of research in which the researcher manipulates or intervenes on certain variables and then observes the effects or results of the intervention (Akbar et al., 2023). In the context of the method described, research involves steps such as data collection, data processing using calculations, manufacturing and assembling components, as well as testing to see how the system or tool created functions. This type of experimental research is often used in engineering, science, and technology, where laboratory or field testing and experiments are an integral part of research methods (Ratminingsih, 2010).

In experimental research, researchers actively manipulate or intervene on certain variables and then observe and analyze the effects or results of the intervention. Research carried out based on the method described in this flow diagram is included in the type of experimental research. In experimental research, researchers actively manipulate or intervene on certain variables and then observe and analyze the effects or results of the intervention (Akbar et al., 2023).

In this research, the process begins with collecting relevant data, where the researcher collects the information and materials needed to support the research process. After the data is collected, the researcher continues with data processing using certain calculation methods to obtain results or information that will be used in the next stage.

Next, researchers manufacture and assemble the necessary components or systems, such as dynamos, shafts or bearings, which are part of the designed experiment. After the system or tool has been assembled, trials are carried out to

ensure that the tool or system functions according to the research objectives. This trial is the core part of experimental research, where researchers can see directly how the intervention affects the results.

The results of this trial are then analyzed in depth to understand the extent to which the system or tool designed is able to solve the problems that have been previously identified. Finally, the researcher draws conclusions based on the main findings of this study and provides suggestions for further development

RESULTS

Soil processing machines for cassava plants are tools specifically designed to loosen the land so that it is ready to be used for planting cassava. This machine has a rectangular shape and is designed with a suitable size to optimize the soil processing process.

This tool functions to prepare the soil by loosening and cultivating it, so that the soil becomes more fertile and ready to support the growth of cassava plants. This machine is designed with a rectangular structure that provides stability and efficiency during operation. The size of the machine is adjusted in such a way that it can work effectively on various types of land, both large and limited, making it easier for users to operate.

With its ergonomic shape and compact size, this machine is not only able to increase cassava farming productivity, but also simplifies the land preparation process, making it faster and more efficient than traditional methods as the results of previous research that has been conducted. (Ariningsih, 2018; Budiawati et al., 2016; Kaur et al., 2023)

DISCUSSION

A. Motor Power Planning

It is known that the petrol motorbike has a power of 7 HP, with maximum power at 3600 rpm and average idle speed at 2000 rpm. To calculate the power used, we first convert the motor power from HP to watts, namely 7 HP multiplied by 746 watts/HP, resulting in 5222 watts or the equivalent of 5.2 kW. Then, the design power is calculated using a correction factor of 1.5. So, the design power is 1.5 times 5.2 kW, which is 7.8 kW. Thus, the power used at an idle speed of 2000 rpm is 7.8 kW.

B. Transmission Shaft Planning

For planning the pulley, it is known that the planned pulley diameter is 8 inches or 203.2 mm. To determine the exit rotation (n_2), the rotation ratio equation is used, where n_1 is the engine rotation of 2000 rpm, d_p is the diameter of the petrol motor pulley of 72 mm, and D_p is the diameter of the transmission pulley of 203.2 mm. By plugging these values into the equation, we get $n_2 = 2000 \times (72 / 203.2) = 708.66$ rpm.

In planning the shaft, it is known that the motor power is 5.2 kW and the n_2 rotation is 708.66 rpm. The correction factor for the power to be transmitted is 1.5, so the planned power (P_d) is $1.5 \times 5.2 = 7.8$ kW. To calculate the design twisting moment (T), the formula $T = 9.74 \times 10^5 \times P_d / n_2$ is used. By

substituting the Pd and n2 values, we obtain $T = 9.74 \times 10^5 \times 7.8 / 708.66$, which produces a twisting moment of 10,720.51 kg.mm.

C. Transmission Shaft Planning

It is known that the design engine speed (n2) is 708.66 rpm, with the number of teeth on the large sprocket (T2) being 42 and the number of teeth on the small sprocket (T1) being 14. To determine the design engine wheel rotation (n3), a comparison equation is used gear, namely n2 multiplied by the gear ratio T2/T1. By plugging in these values, we get $n3 = 708.66 \times (42 / 14) = 236.22$ rpm.

Furthermore, in the shaft planning, the motor power is known to be 5.2 kW and the n3 rotation is 236.22 rpm. The motor power correction factor (fc) is 1.5, so the design power (Pd) is calculated as $1.5 \times 5.2 = 7.8$ kW. To calculate the design twisting moment (T), the formula $T = 9.74 \times 10^5 \times Pd / n3$ is used. By substituting the Pd and n3 values, we get $T = 9.74 \times 10^5 \times 7.8 / 236.22$, which produces a twisting moment of 32,161.54 kg.mm.

D. V-Belt Planning

It is known that the electric motor has a power of 7 HP and the motor rotation is 2000 rpm, while the design rotation (n2) is 708.66 rpm. To select the belt type, a V type belt is used, with the motor power converted to 5.2 kW. The belt used is type A to suit the n2 plan round.

In selecting the pulley, it is known that the motor rotation (n1) is 2000 rpm and the input transmission rotation (n2) is 708.66 rpm. The reduction ratio is calculated as $n1/n2$, namely 2000/708.66. The selected motor pulley diameter (dp) is 72 mm, while the transmission pulley diameter (Dp) is 203.2 mm. So the resulting calculation of the circumference of the V belt is 1116.86 mm.

E. Chain Planning

For chain calculations, there are two things to look for: the length of the chain and the distance between the sprocket centers. With the known data, namely the number of small gear teeth (Z1) is 14 teeth, the number of large gear teeth (Z2) is 42 teeth, and the distance between sprocket centers (C) is estimated at 35 pitches, to determine the chain size, distance between centers The estimated sprocket (C) is 35 times the pitch. Assuming the chain pitch is 3/8 inch, then the distance $C = 35 \times 3/8 = 13.125$ inches. The chain number digits (other than the last zero) represent the chain pitch when divided by 8 in inches. With a closer chain pitch, the result is 56 pitches. If the pitch is 3/8 inch, then the chain length is $56 \times 3/8 = 21$ inches. Thus, the actual distance between the sprockets is 13.25 pitches.

CONCLUSIONS AND RECOMMENDATIONS

In the era of technological progress, the industrial sector, including agriculture, is experiencing rapid transformation. Increasingly advanced machine technology opens up opportunities to increase efficiency and productivity, but challenges remain, especially related to the cost and

accessibility of modern technology for farmers. There are still many farmers who depend on traditional tools because the prices of modern tools are high.

To overcome this problem, we designed a soil processing machine that not only uses modern technology but is also affordable and practical. This machine is designed with a dual transmission system that optimizes the soil processing process. This machine is capable of loosening the soil with higher efficiency than traditional methods, and is adapted for various types of land. With an ergonomic design and compact size, this machine can increase agricultural productivity and make land preparation easier.

Motor and transmission power planning is carried out carefully to ensure that the machine operates efficiently. Motor power is converted and calculated with a correction factor to determine the design power. The planning of the pulleys, chains and V-belts is adjusted to the engine rotation and workload, ensuring that the engine components function optimally.

To increase the impact of this innovation, it is recommended that further evaluation and testing be carried out to ensure the machine can operate well in various field conditions. Further research into the factors that influence machine efficiency, as well as the development of more affordable versions, could help increase adoption of this technology among farmers. In addition, counseling and training for farmers on the use of these machines will go a long way in increasing their utilization and speeding up the transition from traditional methods to modern technology.

FURTHER STUDY

Further studies need to be conducted to evaluate the performance of tillage machines in various types of soil, such as clay, sand, and sandy soil. This test will provide information about the extent to which the machine can adapt to various ground conditions and whether modifications need to be made to increase its efficiency. Research into machine operational and maintenance costs should be conducted to assess economic sustainability for farmers. This study may include an analysis of the total cost of ownership, including initial price, operating costs, and routine maintenance costs. This information will help determine whether the machine is truly affordable and provides economic benefits for farmers.

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