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Fabrication and Testing of Sugarcane Bud Cutting Machine

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Abstract - Sugarcane is an important commercial crop widely cultivated to produce sugar and other by-products. In traditional farming methods, sugarcane buds are cut manually for planting purposes, which requires more labor, time, and physical effort. Manual bud cutting may also cause damage to the buds and lead to wastage of planting material. To overcome these problems, the present project focuses on the fabrication and testing of a sugarcane bud cutting machine that can improve efficiency and reduce manual work in agricultural practices. The developed machine is designed using simple mechanical components such as a frame, cutting blade, shaft, pedal or lever mechanism, and a clamping arrangement to hold the sugarcane stalk during cutting. The machine operates by applying force through a pedal or lever that activates the cutting blade to remove the bud from the sugarcane node accurately. The design ensures proper cutting without damaging the bud eye, which is essential for successful germination.

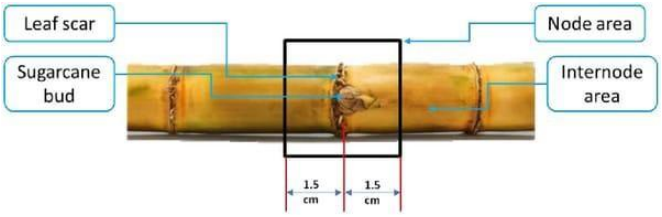
Key Words: Sugarcane Bud Cutting, Bud Chipping Machine, Agricultural Machinery, Sugarcane Plantation, Semi-Manual Bud Cutting Machine, Mechanization in Agriculture, Cutting Mechanism.

1. INTRODUCTION

Sugarcane is one of the most important commercial crops cultivated in tropical and subtropical regions, especially in India. It plays a vital role in the agricultural economy as it is used for the production of sugar, jaggery, ethanol, and other by-products. The success of sugarcane cultivation mainly depends on the quality of planting material and the efficiency of the planting process. In conventional methods, sugarcane is planted using whole cane stalks or setts, which require a large quantity of seed material and involve high labour costs.

The traditional method of extracting buds from sugarcane is done manually using knives or simple tools. This process is time-consuming, labour-intensive, and often leads to improper cutting, resulting in damage to the bud eye. Such damage reduces the germination rate and affects the overall yield of the crop. In addition, continuous manual operation causes fatigue and may lead to injuries for the workers.

To overcome these limitations, the use of sugarcane bud cutting machines has gained importance in modern agriculture. These machines are designed to remove buds from the sugarcane stalk quickly and accurately with minimal damage. Mechanization of the bud cutting process helps in reducing labour effort, saving time, and improving productivity. Various types of machines such as manual, semi-manual, and motorized bud cutting machines have been developed to suit different farming needs.



The present project focuses on the fabrication and testing of a sugarcane bud cutting machine that is simple, cost-effective, and easy to operate. The machine incorporates a cutting mechanism along with a clamping system to ensure proper holding of the sugarcane during cutting. By using this machine, it is possible to achieve uniform cutting of buds, reduce wastage, and enhance efficiency in sugarcane cultivation. This project contributes to the advancement of agricultural mechanization and supports farmers in improving their productivity and reducing operational costs.

2. LITERATURE REVIEW

Roshanlal Vishwakarma (2009) developed a simple grafting tool for extracting buds from sugarcane stalks. The device uses a hand-operated lever with a hemispherical cutting blade to remove the bud along with a small portion of cane. It provides a clean cut in a single operation and can produce around 250 buds per hour, while experienced operators can achieve up to 400 buds per hour. This innovation helped reduce seed wastage and improve efficiency in bud extraction.

Ningappa H. Kuri (2013) studied the limitations of traditional hand-operated machines, which often cause fatigue, muscle pain, and injuries due to continuous manual operation. To overcome these issues, a pedal-operated bud cutting machine was proposed. This design reduces human effort by using foot force instead of hand force and improves productivity by incorporating a double cutting tool capable of cutting two buds simultaneously.

Suraj S. Magdum (2015) identified that cutting tools in existing machines become blunt after continuous use, which

reduces cutting efficiency and may damage the buds. To solve this problem, interchangeable cutting tools were introduced, allowing easy replacement and ensuring consistent performance during long working hours.

Sanjay Patil (2016) focused on improving cutting accuracy and safety. In traditional machines, slippage of the sugarcane stalk during cutting can lead to improper cuts and wastage. A clamping mechanism was introduced to hold the stalk firmly and prevent movement. This improvement ensures proper cutting of buds and reduces the risk of injury.

3. METHODOLOGY

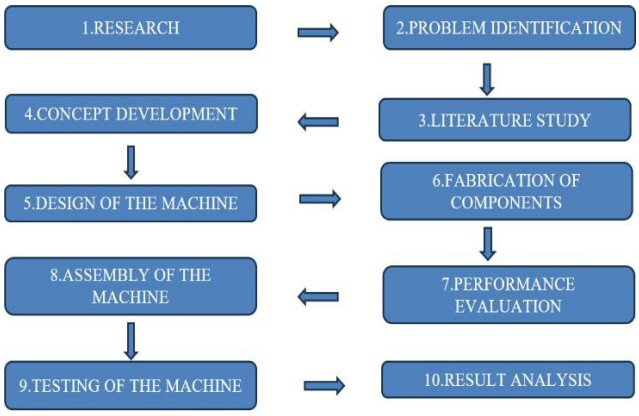


Fig -1: Methodology Block Diagram

3.1 PROBLEM IDENTIFICATION

In traditional sugarcane cultivation, bud cutting is performed manually using knives or simple hand tools. This method requires significant human effort and is time-consuming, especially for large-scale farming. Improper cutting may damage the bud eye, which directly affects germination and crop yield. Workers may also experience fatigue, muscle pain, and injuries due to continuous manual work. Therefore, there is a need to develop a machine that can reduce labour effort, improve cutting accuracy, and increase productivity.

3.2 DESIGN OF MACHINE

The design of the sugarcane bud cutting machine was developed by considering simplicity, efficiency, and ease of operation. The machine consists of a rigid frame, cutting blade, shaft, pedal/lever mechanism, and clamping system. The design ensures proper alignment of the sugarcane stalk and accurate positioning of the cutting blade. Special attention was given to the safety of the operator and smooth functioning of the machine. The design also allows easy maintenance and low manufacturing cost.

3.3 MATERIAL SELECTION

Proper selection of materials is essential for the durability and performance of the machine. Mild steel was chosen for the frame because of its strength, availability, and ease of welding. The cutting blade was made of hardened steel to ensure sharpness and resistance to wear during continuous operation. Bearings were used to reduce friction and allow smooth rotation of moving parts. Springs were selected to bring the cutting blade back to its original position after each cut. Nuts, bolts, and clamps were used for secure assembly.

3.4 FABRICATION PROCESS

The fabrication of the machine involved several manufacturing processes. Mild steel bars and plates were cut to the required dimensions using cutting tools. Welding was carried out to join the frame components and ensure structural stability. Drilling operations were performed to create holes for bolts and shafts. Machining processes were used to shape and finish the cutting blade and other components. Proper care was taken during fabrication to maintain accuracy and alignment of all parts.

3.5 ASSEMBLY OF COMPONENT

After fabrication, all components were assembled carefully. The cutting blade was mounted on a shaft and supported by bearings to allow smooth movement. The pedal or lever mechanism was connected to the blade using a linkage system. A clamping device was installed to hold the sugarcane stalk firmly during the cutting operation. All parts were tightened securely to avoid vibration and ensure proper functioning of the machine.

3.6 TESTING OF MACHINE

The fabricated machine was tested using actual sugarcane stalks to evaluate its performance. Different samples of sugarcane were used to observe the cutting action and efficiency. The machine was operated continuously for a certain period to check its durability and reliability. Observations were made regarding ease of operation, cutting accuracy, and safety during testing.

3.7 PERFORMANCE EVALUATION

The performance of the machine was evaluated based on various parameters such as the number of buds cut per hour, time taken for cutting, and quality of the cut. The efficiency of the machine was compared with manual methods. The reduction in labour effort and improvement in productivity were also considered during evaluation. These parameters helped in determining the overall effectiveness of the machine.

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3.8 COMPARISON WITH MANUAL METHOD

A comparison was made between the traditional manual method and the developed machine. In manual cutting, fewer buds are cut per hour and more effort is required. In contrast, the machine increases the number of buds cut per hour and reduces physical strain on the operator. The machine also provides more uniform and accurate cutting, which improves the quality of planting material.

3.9 RESULT ANALYSIS

The results obtained from testing and evaluation were analysed to determine the performance of the machine. It was observed that the machine significantly reduces time and labour while improving cutting efficiency. The advantages and limitations of the machine were identified, and possible improvements were suggested. The analysis confirms that the developed sugarcane bud cutting machine is effective and beneficial for agricultural use.

4. RESULT AND DISCUSSION

The fabricated sugarcane bud cutting machine was tested under practical working conditions using different sugarcane stalks to evaluate its performance. During the testing process, the machine operated smoothly and efficiently without any major mechanical issues. The structure of the machine remained stable, and the cutting mechanism functioned properly throughout the operation. The cutting blade provided a clean and precise cut at the node of the sugarcane, ensuring that the bud eye was not damaged, which is essential for proper germination and crop yield.

The performance analysis showed that the machine significantly improved the efficiency of the bud cutting process compared to the traditional manual method. In manual cutting, the operator can cut approximately 120–150 buds per hour depending on skill and effort, whereas the developed machine achieved a cutting capacity of around 250–300 buds per hour. This indicates that the machine nearly doubles the productivity and reduces the time required for the operation. The increased productivity makes the machine suitable for handling large quantities of sugarcane in a shorter time.

The pedal or lever-operated mechanism played a key role in reducing human effort. By utilizing foot force instead of continuous hand operation, the machine minimizes operator fatigue and allows longer working durations without discomfort. Additionally, the clamping mechanism ensured that the sugarcane stalk was held firmly in position during cutting, preventing slippage and enabling accurate and uniform cutting of buds. This resulted in improved quality of planting material and reduced wastage.

From a safety and usability perspective, the machine was found to be simple to operate and did not require highly skilled labour. The design minimizes direct contact with the cutting blade, thereby reducing the risk of injuries. However, it was observed that the cutting blade may become blunt after prolonged use, which can affect cutting efficiency. Regular maintenance and sharpening of the blade are necessary to maintain optimal performance.

Table -1: Comparison of Results

Manual Method (pieces/hr)	Semi-Automated (pieces/hr)
1300 – 1500	2800 – 3000

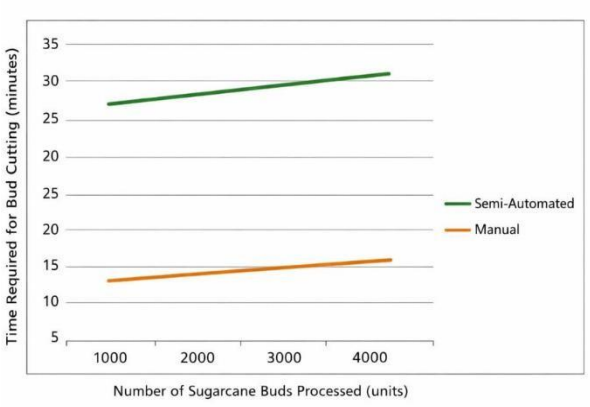

Fig -1: Testing Result Graph

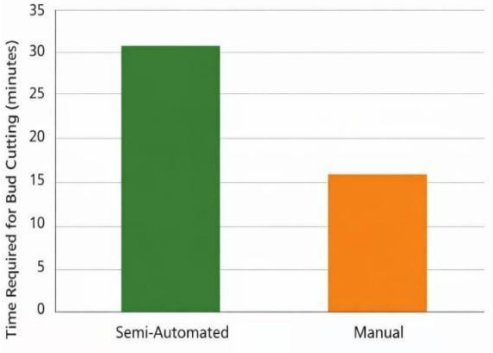

Fig -2: Bar Chart

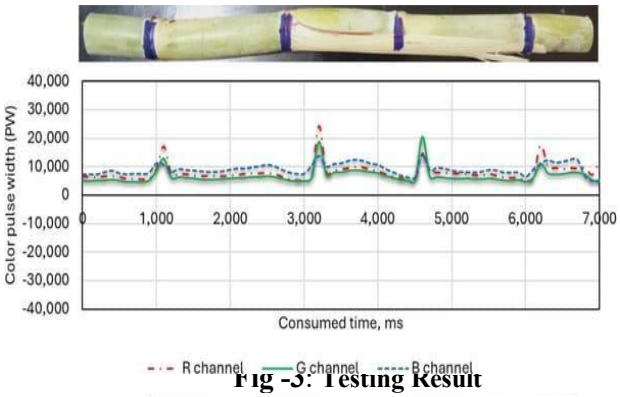

Fig -3: Testing Result

Fig -4: Cutting Accuracy

5. CONCLUSIONS

The project on fabrication and testing of a sugarcane bud cutting machine was successfully carried out with the objective of improving the efficiency of bud cutting operations in sugarcane cultivation. The developed machine effectively addresses the limitations of traditional manual methods, which are time-consuming, labor-intensive, and prone to errors. By incorporating a simple mechanical design with a cutting blade, pedal/lever mechanism, and clamping system, the machine ensures accurate and uniform cutting of sugarcane buds without causing damage to the bud eye. The performance evaluation of the machine demonstrated that it significantly increases productivity, achieving a higher number of buds cut per hour compared to manual methods. It also reduces the time required for operation and minimizes physical effort, as the use of a pedal mechanism decreases operator fatigue. The clamping arrangement further improves cutting accuracy and safety by preventing slippage of the sugarcane during operation. The machine is economical, easy to operate, and requires minimal maintenance, making it suitable for small and medium-scale farmers. It contributes to reducing labor costs and supports the mechanization of agricultural practices. However, certain limitations such as blade wear over continuous usage highlight the need for regular maintenance and possible design improvements.

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