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RESEARCH ARTICLE

# DESIGN AND FABRICATION OF SUGARCANE BUD CUTTER MACHINE FOR IMPROVED FARM PRODUCTIVITY

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**ABSTRACT**

Sugarcane is a very important crop especially in a country like Pakistan where millions of people use it regularly. The sugarcane farming in Pakistan is extended from small land farms to cooperate farming. The modern machinery equipped with high technology tool is developed to make the easier cultivation of the sugarcane. But this access to this machinery is only to the corporate farmers due to its high cost. It is therefore necessary to develop a machine that can provide better results, offer higher profits but still cost less and is easier to operate. As, in the traditional method of planting sugarcane, sugarcane is cut into pieces and buried. However, only a sprout is needed to grow sugarcane and the other part of sugarcane is wasted. The design of our machine helps to cut single bud from sugarcane and saves time compared to hand-made and other cutting processes. This project aims to simplify the process of extracting buds using the above-mentioned machine that requires less human labor, less investment and saves time thus proving a lucrative investment for every farmer. The purpose of the development is to improve the sugarcane germination with the less quantity of sugarcane used. In this method only buds will be used to grow the sugarcane nursery. The initial weight of the sugarcane ranges from 0.85 kg to 1.15 Kg. the length of the sugarcane varies from these selected stalks were 50 to 79 inches. The total weight of these three sugarcanes was 3.05 kg, while after the removal of the buds it was 2.31 Kg as the buds' weights about 0.74 Kg. This method of sugarcane production will improve the farm productivity and sustainability.

**KEYWORDS**

Sugarcane, Bud Cutter, Farm Productivity, Sustainability

## 1. INTRODUCTION

Sugarcane is an important industrial and financial crop in Pakistan and in many parts of the world. The average sugarcane production in Pakistan is 450-500 kg per hectare which is very low compared to other sugarcane production in other countries. Agronomic factors such as crop preparation, bed preparation, planting methods and timing, water availability, fertilizer application, ratoon crop management, harvest time, crop type and crop protection measures significantly affect their production. All of these factors also contribute to production costs. It is noteworthy that the cultivation of sugarcane was done with the aim of crushing sugar cane for the formation of sugar products. Products such as alcohol used in the pharmaceutical industry, ethanol used as fuel, bagasse used for paper and chipboard production. Pakistan occupies an important position in the world's sugarcane producing countries. It is ranked fifth in sugarcane production and approximately 15$^{th}$ place in sugar production. By 2020, production of sugarcane in Pakistan was 81 million-tons. Sugarcane production in Pakistan increased from 23.2 million-tons in 1971 to 81 million-tons by 2020 increasing at an annual rate of 3.58%.

About 1.2 million hectares of sugarcane is cultivated in Pakistan. In typical sugarcane planting system, about 6-8 tons per hectare is used as planting material, consisting of about 36,000 stalk pieces with 2-3 branches. Cutting sugarcane with one, two or three shoots is known as sets used as seed. This large number of planting material poses a significant problem in the transport, management and storage of sugarcane and deteriorates rapidly thereby reducing the viability of the sugarcane and its subsequent germination. Another way to reduce the price and improve the quality of sugarcane seeds would be to plant axillary cutting of the sugarcane stalk, known as buds. These buds are very small, easy to transport and very economical.

The research work done on the design of the bud cutter and bud chipper machines are presented here. Parthasarathy et. al., (2022) worked on the design and development of multi-purpose brush cutter for agricultural operations. Madhur et. al., (2022) design and development of sugarcane bud chipping machine. Magdum et. al., (2016) sugarcane bud cutting machine. Design and fabrication of semiautomatic sugarcane bud cutting machine.

Buds' technology promises good results in the rapid production of new varieties of sugarcane. The remaining sugar can be used to make juice or sugar or a jaggery. Seed demand is reduced to less than one ton per hectare. In Pakistan three sets of sprouting method of sugarcane cultivation are popular. In this way the required number of seed is a total of 8-10 ha$^{-1}$ tons. Decrease in seed rate and increasing the rate of profitability are the main objectives of designing the bud cutting machine for small scale farmers.

## 2. METHODOLOGY

### 2.1 Design of Bud Cutting Machine

A bud cutting machine was designed for cutting the bud to produce the

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seed and utilized the remaining sugarcane stalk in a productive manner. Firstly, the machine design was done in the AUTOCAD as shown in Figure 3.1. This bud cutter machine works on the hybrid mode, Pedal based through the push power of the foot of the person sitting on the seat of the machine and cut the sugarcane bud and other is based on the electric mort attached on it. This pedal bud cutter machine is highly more comfortable as compared to the hand-operated due to improved cutting efficiency based on the easy performance of the operator.

The cutting blade moves down by pushing the pedal and upwards automatically due to the spring connection. After placing the sugarcane in the cutting area, the operator pushes the pedal while sitting on a comfortable chair. The suitable material was used for each component of the machine. The machine cuts the buds of equal size from nodes of sugarcane stalks that are used as seeds and which contain undamaged buds.

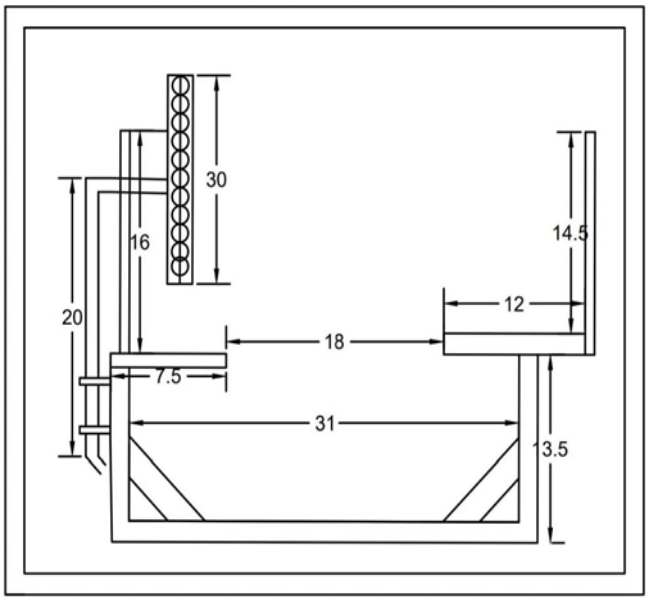


**Figure 1:** Design of Bud Cutting Machine

## 2.2 Working Principle

### *2.2.1 Manually Pedal Operated*

Healthy, free of pests and diseases about 6-8 months age sugarcane is used for making buds. The sugarcane from which the buds are extracted is placed under the cutting blade. Then the cutting blade is operated with the help of a foot-driven pedal that is operated through a series of connecting mechanisms. To facilitate the placement of cutter, a circular hole equivalent to the cutter diameter is drilled to the plate and the cutter is allowed to move through the hole. The required cutting force is created by the force applied by the pedal. The metal blade is moved allowing the cane bud to be removed during sinking. So, when one rotation is completed, one bud is released from the cane. Sugarcane must be rotated to gain the bud front towards the operator to analyzed the condition of the bud before cutting.

**Figure 2**: Bud Cutting Machine

### *2.2.2 Motor Operated*

The single-phase AC motor is held in a channel which is fixed to the base using bolts. The motor is connected to the circular disc. To facilitate the placement of cutter, a circular hole equivalent to the cutter diameter is drilled to the plate and the cutter is let through the hole. The up and down movement of the blade is connected to the rod which is connected to the motor output circular disc with the bush. The gear box is used to reduce the motor speed at the optimum level.

## 3. Results

The bud cutting was performed using three different sized sugarcane stalks as presented in the table 3.1. The initial weight of the sugarcane ranges from 0.85 kg to 1.15 Kg. the length of the sugarcane varies from these selected stalks were 50 to 79 inches. The total weight of these three sugarcanes was 3.05 kg, while after the removal of the buds it was 2.31 Kg as the buds' weights about 0.83 Kg.

**Table 1:** Bud cutting from three different sized sugarcane stalk

| Sr. No. | Weight of complete sugarcane (Kg) | Length of complete sugarcane (Inch) | Weight of sugarcane without buds (Kg) | Weight of buds removed (Kg) | Number of buds removed |
|---|---|---|---|---|---|
| 1 | 1.15 | 79 | 0.85 | 0.30 | 15 |
| 2 | 1.05 | 70 | 0.80 | 0.25 | 12 |
| 3 | 0.85 | 50 | 0.66 | 0.19 | 10 |
| Total | 3.05 | 199 | 2.31 | 0.74 | 37 |

To calculate the benefit under this method, the average weight of sugarcane and bud was consider based on the above three stalks. The average weight of the sugarcane was considered 1.0 Kg, and the average weight of the bud was considered as 0.25 Kg. As, 60,000 plants is the desired requirement in one acre, to meet the desired plant population the average seed application is about 4000 kg in an acre in Pakistan. From this average bench mark weight of Bud (0.25 kg), the seed requirement will reduce from 4000 kg to 1000 Kg with the saving of about 3000 Kg per acre sugarcane.

## 4. Conclusion

The designed machine is easy to operate, reduced the labour cost with effective cutting speed, low capital and operational cost, environment friendly, less seed damage as only the bud is removed from the sugarcane. In rural areas people are faced with problems such as less availability of persons for work, fatigue in the workforce. So, we introduce both motor and pedal operated sugarcane bud cutter machine. All of these problems are eliminated and this machine can be used successfully in increasing the productivity of the sugarcane. This project is providing high return on small investments and simplifying the process of cutting sugarcane bud cutter, and it open the entrepreneurship for the engineering students.

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