



# Design and Fabrication of Sugarcane Bud Cutting Machine

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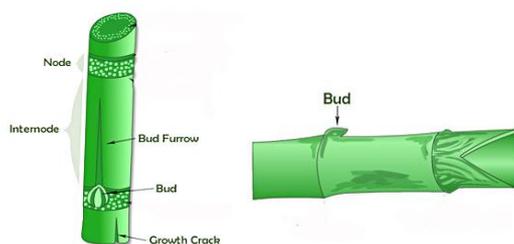
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## Abstract:

In today's world, sugarcane accounts for 80% of sugar produced worldwide. The sugarcane industries just borrow the sugarcane stalks as a whole from the farmers who actually grows it and is further processed in a conventional sugar processing machine without actually separating the planting material it's known as Bud (which acts as a seed), thus wasting it by crushing it or maybe in some other ways. What we actually intend to do is to solve the above-mentioned problems by creating a AUTOMATED machine which will be employed to separate the bud and the furrow part of the sugarcane so that they can be used in future for sugar processing and obtaining the planting material. These bud chips are less bulky, easily transportable and more economical seed material. The left-over cane can be well utilized for preparing juice or sugar or jiggery. In sugarcane inter node cutting operation, sugarcane is cut at its nodal part in small pieces and bud is separated from the sugarcane for seedling purpose. The existing (traditional) tools used for bud cutting of sugar cane are unsafe, messy and need skill and training. The risk of injury is also too high this necessitates the development of a bud cutting machine for sugar cane. The specially designed blades are prototyped using stainless steel Material attached to the hub. Hub is mounted to the shaft which is driven by the worm gear through chain drive. The bud chip technology holds great promise in rapid multiplication of new cane varieties. The prototype was tested and the initial results indicated that equipment has reduced the manual effort, as required for generating the sugar cane buds as compared traditional tools. The whole equipment is simple with additional safety measures.

## 1. INTRODUCTION

Agriculture is one of the most significant sectors of the Indian Economy. Agriculture is the only means of living for almost two thirds of the workers in India. The agriculture sector of India has occupied 43% of India's geographical area, and is contributing 16.1% of India's GDP. There are number of crops grown by farmers, Sugarcane is one of the important commercial crops grown in India. Sugarcane is grown primarily in the tropical and sub-tropical zones of the southern hemisphere. Sugarcane is the raw material for the production of white sugar, jaggery. It is also used for chewing and extraction of juice for beverage purpose. In addition to being the third most important cash crop in India, sugarcane ranks third in the list of most-cultivated crops, coming after paddy and wheat. India is one of the largest sugarcane producers in the world, producing around 300 million tons of cane per annum. The production of sugar is the second largest agro-processing industry in the country, after cotton and textiles. India has more than 566 sugar mills. About 4 million sugarcane farmers and a large number of agricultural labourers are involved in sugarcane cultivation and auxiliary activities, constituting 7.5% of the rural labour force. In addition, the industry provides employment to 500,000 skilled and semi-skilled workers in rural areas.



**Figure.1. Sugarcane Bud Chippers**

There are several methods for sugarcane bud chipping. It is by manually, and also by the use of machines. Manual bud chip

cutting with hand knife is a common practice. These traditional tools used for bud chipping of sugar cane are unsafe, messy, minimum productive and need skill and training. The risk of injury is also too high. This necessitates the development of an automated sugarcane bud chipping machine. The device, called sugarcane bud chipper, is consists of specially designed blade with a quadrant edge to surgically cut out the buds in a high impact operation, with clean finish and practically no damage to the cane. "Using this device a person can remove nearly 100 buds in an hour. Handling capacity the machine can also chop the cane into small pieces, is flexible, and can handle various sugarcane sizes and diameters. Machine details The bud-chipper consists of a Mounting Frame, the sub-assemblies such as electric motor, worm gearbox, transmitting shaft, chain drive, bearings, and rotor hub and blades arrangements are mounted on the frame.

**Kiran Bhange et al [1]** studied that Sugarcane planting with traditional methods is costly, time-consuming and necessary compression of buds in the field is not achieved easily because of stalk planting in sugarcane. In tradition planting method, great human force and high volume of sugarcane stalk in hectare are required. To solve this problem and mechanizing of sugarcane planting, we suggest the application of machine vision system and Image Processing methods to identify nodes from sugarcane and to plant it as a seed by planting machines.

**Abel Roy et al [2]** studied that the project aims to design and fabricate semi-automated sugarcane bud chipping machine for agriculture, to reduce farmer's efforts and to increase production of agriculture products. In this machine two operations are carried out at a time. The operations that can be carried out on this machine are sugarcane internode cutting and sugarcane bud scooping. In sugarcane internode cutting operation, sugarcane is cut at its nodal part in small pieces and in the sugarcane bud scooping operation eye bud is scooped

out from the sugarcane for the seedling purpose. This operation is mainly based on scotch and yoke mechanism. After the completion of this project, following conclusions was made, i.e., the semi-automated sugarcane bud chipping machine is fabricated and assembled as per the proposed design. This machine removes the buds by cutting the node as well as scooping out the bud from the cane simultaneously.

**Suraj s magdumet al [3]** studied that in tradition planting method, great human force and high volume of sugarcane stalk in hectare are required. The project aims to design and fabricate pedal operated sugarcane bud chipping machine for agriculture. In this method the sugarcane is fed to the cutting region manually, when the operator starts pedalling the cutting action starts and the sugarcane buds are cut along with the stalk. Even the unskilled operator can operate the machine.

## 2. OBJECTIVE

The main objective of the project is to design and fabricate a sugarcane bud cutting machine which can allow the farmer to separate the sugarcane bud in a form which can be utilized for sugarcane plantation, with ease and thus reducing the manual work of farmer and increases the production and to minimize the wastage of stalk part. To achieve these objectives Change Manual Method in to semi- Automatic.

## 3. METHODOLOGY

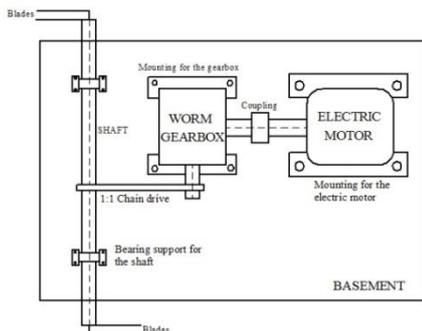
### 3.1 CHANGE MANUAL METHOD IN TO AUTOMATIC

– By using appropriate capacity of single phase motor, gearbox which will reduce wastage and increase productivity as it will reduce strain on hands of worker and more emphasis on safety of operator.

**3.2 SAFETY** – Highest priority is given to safety of the operator.

### 3.3 WORKING PRINCIPLE

Working Principle Sugarcane bud chipper machine works on Rotary mechanism. Figure 3.3.1 shows an electric motor is coupled to a speed reducer worm gearbox. The high speed-low torque rotary power from the electric motor is converted into low-speed high torque power output using a worm gearbox and it is made available at the shaft to which the blades are fixed through the chain drive. The cutting action of blades takes place due to the rotary motion of the blades in conjunction with the contour of the blade itself. The operator has to manually feed the sugarcane stalk in an axial direction with respect to the rotation of the blades. The blade design and machine setup are designed so that for each rotation of blades, one bud from the stalk is cut and in the next rotation of the blades, the next bud is cut and so on. i.e., for each rotation, each bud from the sugarcane stalk is being cut.



**Figure.2. working principle of sugarcane bud cutting machine.**

## 4. DESIGN AND CALCULATIONS

The Main objective of this project is cut one bud per rotation of the cutter and optimum time required to cut one bud is 2.667 seconds. This can be achieved if the cutter rotates at 22.5 rpm.

### 4.1 SPEED CALCULATIONS

Speed of the Motor (N1) = 1425 rpm

Required Speed of Electric motor (N2) = 22.5 rpm.

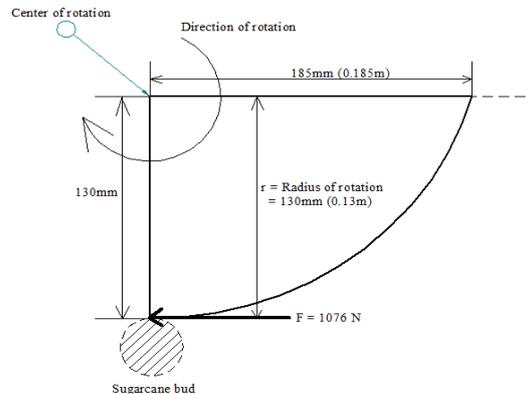
Gear ratio =  $N1/N2$  ..... 23-1 [DDHB Vol 2, Pg. no. 23.6 by K. Lingaiah]

$$= 1425/22.5$$

Gear ratio = 63.3:1

Standard Gear ratio 70:1.

### 4.2 POWER AND TORQUE CALCULATIONS



**Figure .3. Actual blade dimensions with force ‘f’.**

From the literature survey, we came to know that the force required to cut the sugarcane bud is 1058.49 from two blades. We know that the relation for the torque from the figure 4.1.1 is given by

$$T = F * r$$

$$T = 1059.48 * 0.13$$

$$T = 137.73 \text{ N-m.}$$

**Required power**

$$P = \frac{2\pi NT}{60} \text{ Watt}$$

$$P = \frac{\pi^2 (20.5)(137.73)}{60}$$

$$P = 295.6 \text{ Watt.}$$

There will be power losses due to the efficiency of the power transmission.

$$\text{Power required, } P = \frac{295.6}{0.95 * 0.9 * 0.85 * 0.9}$$

$$P = 451.93 \text{ Watt}$$

$$P = \frac{451.93}{745} \text{ HP}$$

$$P = 0.60 \text{ HP}$$

Since 0.60 HP motor is not available in the market, 1 HP motor is chosen.

## 5. FABRICATION OF DIFFERENT PARTS OF MACHINE

### 5.1 FABRICATION OF FRAME

To mount various components and sub-assemblies of the sugarcane bud cutting machine such as power trains, shaft, blade and motors and various other components to absorb the vibrations and the impact forces that are caused due to the operation of the machine and to provide proper position for the sub-assemblies the material selected is mild steel to build the frame due to the high density and strength to withstand impact forces.

- Mild steel plate of dimension 95x60x65mm, should be cut with the hacksaw or motorized metal cutter.
- Wooden plates of required dimensions to accommodate the iron plates have to be placed on the frame.
- Then the holes should be drilled on the wooden plates using drilling machine.
- Holes provided on the wooden plate along with various other fasteners and bearings are used to mount the iron plates.

A cross beams and slender members may be provided to the frame to withstand high loads during operation.



Figure.4. Frame And Column

## 5.2 MOUNTING DEVICES

The sub-assemblies such as electric motor, worm gearbox, transmitting shaft, chain drive, bearings, and rotor hub and blades arrangements are mounted on the frame as follows,

- At first, the motor is bolted to the wooden plate at one of the ends of the frame.
- Then the motor is coupled to the worm gearbox through input shaft.
- The worm gearbox is also mounted on the frame by fastening the casing.
- The output shaft from the worm gearbox is coupled to the shaft carrying blades
- The power trains are provided with the synchronizers to step up and step down the torque as per requirements.



Figure.5. assembly of worm gearbox with motor on mounting frame.



Figure.6. assembly of worm gearbox, chain drive with main shaft on mounting frame.



Figure.7. assembly of cutting blade with main shaft on mounting frame



Figure.8. final assembly of sugarcane bud cutting machine

## 6. RESULTS AND ANALYSIS

The sugarcane bud cutting machine based on the required consideration and objective is made ready with all the required connection and support on the mild steel frame. The outcome of the fabricated machine is to separate the buds from the sugarcane stalk. In the traditional way of plantation nearly 3 tons of sugarcane is used for plantation per Acre. The sugarcane with 2 to 3 buds known as seed is planted continuously. In this traditional method nearly 1.5 tons of useful sugarcane stalk is being wasted per Acre for plantation. With the help of the sugarcane bud cutting machine the internodes bud cutting is made possible so that nearly 1.8 tons of sugarcane stalk per acre can be saved which can be used for juice extraction and jiggery making. The cost of sugarcane bud chipping machine is reduced by 68% when compared to available machines, so that small farmers can afford this easily. When compared to the traditional sugar cane bud chipping tools the newly designed and developed sugar cane bud machine is Economical also, this new machine has totally eliminated the manual effort required in punching the sugar cane machine.

## 7. CONCLUSIONS

After the completion of this project, following conclusions were made, i.e., the semi-automated sugarcane bud chipping machine is fabricated and assembled as per the proposed design. Through the development of sugarcane bud cutting machine, slicing the inter-node is made possible, so that nearly 1.8 tons of sugarcane stalk can be utilized which is considered as wastage in traditional method. With the development of the

sugarcane bud cutting machine the workload on the labour is reduced and the productivity increased.

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