

# Pneumatically Operated Sugarcane Bud Cutting Machine

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**Abstract** - Sugarcane is the main source of sugar in Asia and Europe. Sugarcane is the raw material for the production of white sugar, jaggery, and Khansari. It is also used for chewing and beverage purposes. The sugarcane cultivation and sugar industry in India plays a vital role in socio-economic development in rural areas. About 7.5 percent of the rural population, covering about 45 million sugarcane farmers, their dependents, and a large number of agricultural labors are involved in sugarcane cultivation, ancillary activities. There are various methods for sugarcane bud cutting. They are done manually and also with the use of machines. Manual bud chip cutting with a hand knife is a common practice. These traditional tools, used for bud cutting are unsafe, messy, minimum productive and they need skills and training. The risk of injury is very high. This necessitates the development of an automated sugarcane bud cutting machine.

**Key Words:** (hemispherical cutter, pedal operated, compressor, sugarcane buds, pneumatic cylinder

## 1. INTRODUCTION

Agriculture is one of the foremost significant sectors of the Indian Economy. Agriculture is that the only means of living for nearly two-thirds of the workers in India. The agriculture sector of India has occupied 33% of India's geographical region and is contributing 15.1% of India's GDP. Agriculture still contributes significantly to India's GDP despite the decline of its share in India's GDP. There are a number of crops grown by farmers. These include different food crops, commercial crops, oilseeds, etc., sugarcane is one of the important commercial crops grown in India. Sugarcane is the main source of sugar in Asia and Europe. Sugarcane is grown primarily within the tropical and sub-tropical zones of the hemisphere. Sugarcane is the staple for the assembly of white sugar, jaggery, and Khandsari. It's also used for chewing and extraction of juice for beverage purposes. The sugarcane cultivation and sugar industry in India plays a significant role in socio-economic

development within the rural areas by mobilizing rural resources and generating higher income and employment opportunities. About 7.4 percent of the agricultural population, covering about 34 million sugarcane farmers, their dependents, and an oversized number of agricultural labors are involved in sugar cane cultivation, harvesting, and ancillary activities.

The principal advantage of bud chips is a substantial saving in seed material. Seed requirement is reduced to but one tone. The farmers usually remove the bud chips from whole cane employing a sharp-edged knife in such the simplest way that every bud features a little portion of the stem. The strategy is laborious time consuming and dangerous. The seed cutter machines can efficiently conserve time and labor and price because it chips more buds in less time. The main objective of our project is to perform job holding and cutting operations effectively with less human effort by incorporating a machine with pneumatic power. This also takes less time because of its quick action. This pneumatic sugarcane bud cutting machine aims to supply far better and faster bud cutting operations with less human effort thereby promoting agricultural activities of sugarcane cultivation.

## 2. DESIGN OF PNUMATUCALLY OPERATED SUGARCANE BUD CUTTING MACHINE

### 2.1 Design of cylinder:

Take pressure 5 bar for cutting sugarcane bud.

Also, take 10 sugarcane for getting an average diameter of sugarcane.

Average Diameter = 40mm

$$P = \frac{F}{A}$$

We get,

Required force = 628.31 N

But, by using maximum permissible shear stress theory.....(PSG Design Databook)

Theoretical force = 75% of the required force

We get,

Theoretical force at forward stroke = 1178N

Theoretical force at return stroke = 990N

Then,

For getting Diameter we used the following equation,

$$D = \sqrt{\frac{4F}{\pi P}}$$

We get, Piston Dia. = 50mm

Rod Dia. = 20mm

Stroke length = 125mm .....(Design datasheet)

### 2.2 Compressor:

Capacity = 10 kg.

### 2.3 Design of Hemispherical cutter:

Material used: medium carbon steel (45C8)

Shape: hemispherical cutter

Cutter length = Avg. Dia. sugarcane + approach + over travel  
 = 40 + 15 + 15  
 = 70mm

Cutter radius = 40 × 0.75  
 = 30mm

Normally portion of bud in sugarcane is 25%, but for getting the desired shape we cut the bud in 75% of sugarcane.

### 2.4 Control Valve: 5/2 foot operated DCV

### 2.5 Design of Frame:

Material for metal square pipes:-Mild Steel

Dimensions of Metal Square Pipes = 25×25 mm

Length of four Vertical square pipes = 675 mm

Length of two Horizontal Square pipes = 700 mm

Length of two horizontal square pipes = 350 mm

Material for angle bars:-Mild Steel

Dimensions of angle bar = 35×35×3 mm

Length of two vertical angle bars = 460 mm

Length of two horizontal angle bars = 280 mm

Length of two horizontal angle bars = 70 mm

### 2.6 Design of Foundation:

- load mass =  $\frac{628}{9.81} = 64\text{kg}$
- of cylinder = 1.2 kg
- of cutter = density × volume  
 = {7850 × 3 (10-3) × 0.07 × 0.06}  
 = 0.1kg
- accessories = PU tube, connectors, angles = 2 kg
- mass = 64 + 1.2 + 0.1 + 2  
 = 67.6 Kg.

## 3. WORKING OF THE SYSTEM

### 3.1 WORKING



**Fig -1: System**

The compressed air from the compressor is used as the force medium for this operation. The machine uses a pneumatic double acting cylinder, foot valves. The arm from the compressor enters the flow control valve. The controlled air from the flow control valve enters the foot valve. The function of foot valves controls the extension and retraction of air from the cylinder at the correct time interval. The 5/2 foot valve is used. In one position air enters the cylinder and pushes the piston so that the cutting stroke is obtained. The next position air enters the other side of the cylinder and pushes the piston return back, so that their leasing stroke is obtained. The speed of the cutting and releasing stroke is varied by the human foot position.

#### 3.1.1 Double-acting cylinder



**Fig -2: double-acting cylinder**

A double-acting cylinder is used where an external force is not available to retract the piston or where high force is required in both directions of travel. They are mostly employed at places where it is needed to produce forces in both directions.

#### 3.1.2 Compressor

Compressor is the air producing machine. They collect the air from the atmosphere. Air compressors are used to raise the pressure of the air by reducing its volume. Air

compressors are available in many configurations and will operate over a very wide range of flow rates and pressures. Compressed air was expelled by primitive man to give glowing embers sufficient oxygen to allow them to flare up into a fire.

### 3.1.3 Hemispherical cutter

The pneumatic cutting machine consists of a single hemispherical movable cutter. The cutter is made of mild steel. The sugarcane is placed in between the cutter and base provided. The moving cutter is moved with the help of pneumatic power, to cut the sugarcane firmly against the fixed cutter.

## 4. RESULT

Sr. no.	Parameter	Cam operated	Lever/Hand operated	Pneumatic operated
1	Cutting rate	100 buds/hr.	400 buds/hr.	1200 buds/hr.
2	Safety	Less	Less	More
3	Wastage	More	More	Less
4	Ergonomics/Comfort	Less	Less	More
5	Cost	High	Low	Moderate
6	Productivity	Moderate	Low	High
7	Complexity	More	Moderate	Less

## 5. FUTURE SCOPE

As the pneumatic operated sugarcane bud chipping machine, the operator does the work on its own but we can replace it by proper mechatronics system. Due to the use of the mechatronics system all operations like cutting of bud and passing of sugarcane can be done automatically. As in our project we use only one double-acting cylinder in the future, we can replace it by multi cylinders from that we get the maximum buds at the same time. Instead of using a single rod cylinder, we can use a double rod cylinder that can operate from both sides and gives maximum bud cutting efficiency of machine in the same stroke.

## 6. CONCLUSIONS

The project carried out by us made an impressive task in the field of small scale industries related to agricultural activities. After comparing different conventional methods of sugarcane bud chipping, we conclude that pneumatically operated sugarcane bud chipping machine is better to extract buds for fresh development of bud as a new plant. By applying this process, we can save the excess loss of time, money, and sugarcane. It gives better ergonomics to the

operator and avoids the wastage of sugarcane which is occurred in conventional methods.

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