

Design and Development of Multi-Purpose Brush Cutter for Agricultural Operations

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Abstract - Sugarcane an industrial crop which is cultivated over more than 130 countries around the world. In India sugarcane cultivation area is expected to be 54.55 lakh hectares. India is the second largest producer of sugar (17.1%) in the world after Brazil. Sugarcane trash (leaves) removal takes 65% time of manual harvesting and which takes 45 to 48% of total cultivation cost. Machinery removal of sugarcane leaves reduces harvest costs, time, and effort. A small sugarcane leaf stripping machine by using the brush cutter was designed and fabricated to deduce these problems. And this cutter is not only designed for leaf stripping process but also for multi-purpose operations such as blowing and vacuum operations. Main components of stripping machine were wire stripper, axial fan and gears. Therefore, designing and manufacturing a sugarcane leaf removing machine using locally available raw materials is of imminent importance. Also, there is a need for manufacturing multi-purpose machine which is helpful for small and marginal farmers. Here we call it as multipurpose brush cutter by adding multiple attachments like sugarcane leaf stripping attachment, blower and vacuum cleaner.

Keywords—Sugarcane leaf remover, Brush cutter, Blower, vacuum, Leaf strimmer

1. INTRODUCTION

Sugarcane, an industrial crop is cultivated in an area of about five million hectares in India, with an annual production of about 310 lakh tonnes (2021). Sugarcane cultivation is one of the most time and labour consuming, arduous operation. Labour work includes detopping of green top and removal of dry trash, spraying pesticides and loading to transport vehicles. Since about 70% of the labour is required for stripping the trash from the sugarcane, there was a need for the development of sugarcane leaf stripper for replacing the total labour requirement. Stripping leaves of sugarcane helps in growth of the plant and yield. Leaf-stripping depends on stripping components which hit and strip the leaves under the effect of centrifugal force to crash the leaves.

Brush cutter is attached with the leaf stripper which is connected by a bevel gear mechanism. Leaf stripper rotates in a way with that of feeding and the stripper removes the trash of sugarcane.

An axial flow fan moves air or gas parallel to the axis of rotation. By comparison, a centrifugal or radial flow fan moves air perpendicular to the axis of rotation. Axial flow fans

are better suited for low-resistance, high-flow applications, whereas centrifugal flow fans apply to high-pressure resistance, low-flow conditions. Typically, the types of fans discussed in this manual can handle “resistances” up to approximately 1 in. of water. Axial fans can have widely varied operating characteristics depending on blade width and shape, number of blades and tip speed. Fans have several applications in modern life; therefore, saving energy and material play crucial roles in their design and manufacturing. Reaching the global goal of saving energy and material necessitates a close analysis of various variables in fans. A vacuum cleaner, also known simply as a vacuum or a Hoover, is a device that causes suction in order to remove dirt from floors, upholstery, draperies, and other surfaces.

2. LITERATURE REVIEW

Prof. A.A. Tamboli et al. In this paper, we studied that sugarcane planting with traditional method is costly, time consuming, requires great human force and high volume of sugarcane stalk per hectares. Also the traditional tools used for bud chipping of sugar cane are unsafe, messy and need skill and training. The risk of injury is also too high. Nowadays, sugarcane node cutting machines are used to reduce the human effort and time. However, these machines do not have control on cutting location. To produce maximum sugar cane traditional method is not suitable as sugarcane node cutting with traditional methods is costly, time consuming and it requires more human effort [1].

R. Abarna et al. In this paper, we came to know that the current method of deploying sugarcane sets proved laborious, time consuming and costly, a farmer, faced acute difficulties in cultivation and alternative method of planting individual saplings did not help. It was hampered by lack of availability of saplings in large numbers. The machine can handle various sugarcane sizes and diameters. Traditional method for cutting sugarcane node cause wastage of sugarcane and time. The sugarcane bud cutting machine is very useful to small scale farmers to cutting sugarcane node. Also, time is saved by this process as compare to the traditional system of sugarcane node cutting. Extra piece of sugarcane bud waste in

small scale farm that can be saved by using sugarcane bud cutting machine that can be used as a fodder for animals [2].

Prof. Mahesh Bhandare et al. In this paper, we were challenged by an engineer to make a machine that can remove nodes from the sugarcane for the plantation purpose, so as to minimize losses as well as time, money and seeds, with this implement [2]. By pressing the food pedal, the unit removes the node from the node of the sugarcane, which is then used for planting. It was hampered by lack of availability of saplings in large numbers. The farmer wondered whether the sugarcane nodes, instead of being planted, could be sown like potatoes on the fields. The device consists of platform, hemi sphere chipping knife, sphere chipping knife, linkage system and handle, it is used to chip out the node from sugarcane for sowing purpose and for tissue culture Novelty of the unit lies in foot lever operated hemi sphere chipping knife which provides gentle cutting of bud without extra loss of sugarcane during sowing. This ultimately gives higher income to the farmer by utilizing the remaining portion of the chipped canes which can be used for making sugar and also for any other purpose. This can also be using the electronic machine and hydraulic machine, This will save time instead of manual working or pedal working type machine, but their cost is high. The hydraulic type of machine is so costly, where the farmers are not able to buy that type of costly machines. Where these consist of a hemispherical blade having a radius of 2.5 cm, in which the sugarcane nodes are having ability for the plantation purpose [3].

3.PROBLEM IDENTIFICATION

Sugarcane is an important commercial crop in India and plays a pivotal role in agricultural and industrial economy of our country. Sugarcane leaves, account for 12%–20% of the mass of sugarcane yield. which, after shredding and return to the field could be used improve the soil structure and help protect the ecological environment. Thus, harvested sugarcane leaves in the field need to be treated separately. In countries with more developed sugarcane cultivation, such as Brazil, India, and Australia, large combined harvesters and collecting vehicles are used to harvest the sugarcane and cut the sugarcane leaves, or tractors with disc brakes are used to crush the leaves.

During the last decade, the agriculture sector in India has experienced a sharp drop in the availability of labour despite the sector contributing significantly to the overall growth of the Indian economy. This conundrum was revealed in recent VDSA (Village Dynamics in South Asia) research at ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) which also revealed that farmers are struggling with having to pay higher wages to those laborers who are still working in the agricultural sector. The problem of labour shortage is severe, as it affects the timely disposition of agronomic operations of crops. Stripping of sugarcane leaf helps in improving the growth of the sugarcane and this process is delayed because of labour shortage. Hence the shortage of labour for sugarcane leaf stripping process is the major problem for small scale and marginal farmers.

However, during manual cutting workers are exposed to a number of health hazards such as fatigue, weather conditions

(high temperatures, rain). Chemical hazards like gases and particulate matter from burning cane, soil, and pesticide residues; Biological hazards such as venomous animals, traumas and fire, ergonomic risks like repetitive postures and movements, physical overload, and mental risks imposed by the work rhythm, constant attention, concentration, and lack of regular pauses.

4.PROBLEM RECTIFICATION

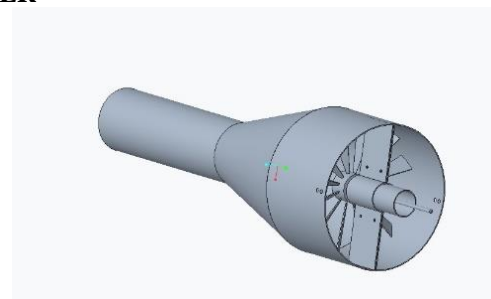
Our proposed solution will be a brush cutter with multiple attachment replacing manual labour for sugarcane leaf trimming and various agricultural works. By replacing labour with brush cutter, the brush cutter operator has the less chance of getting injured by the sharp edges of the sugarcane leaves. And the other thing is that it does not require high effort to clean the garden unlike the manual cleaning. By attaching blower with the brush cutter, it can be used to clean the garden efficiently and easily (can be operated by anyone). Manual removing of sugarcane leaves is time consuming and requires huge amount for wages. Hence brush cutter requires single person to operate. A single person can be able to complete the huge area of work in a day.

5.LIST OF COMPONENTS USED

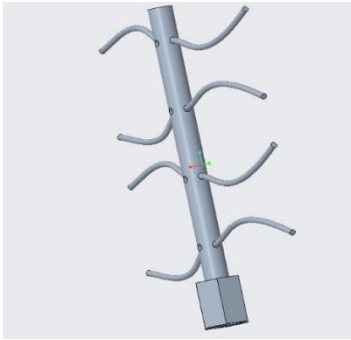
S.no	Name of the Component	Material
1	Shaft	Carbon steel (40C)
2	Rod holder	Aluminium
3	Fan hub	Aluminium
4	Fan	Mild steel
5	Bearing holder	Mild steel
6	Clamp	Mild steel
7	Casing	Mild steel
8	Nozzle	Galvanised iron sheet
9	Blower Handle	Mild steel
10	Vacuum hose	Plastic
11	Strimmer wire	Nylon

6. DESIGN

BLOWER



LEAF STRIMMER



7. FABRICATION

Fan diameter = 15.5 cm
 Inner diameter = 5cm
 Blade angle = 45 degree
 Clearance = 1mm
 Fan area = 18869.19mm²
 No. of blades = 12

3) Bevel Gear Box (Angle Grinder)

No of teeth in pinion = 9
 No of teeth in gear = 32
 Gear ratio = 3.5

9. WORKING PRINCIPLE

Here we were using brush cutter as a primary machine. The blade of the brush cutter is driven by a two strokes engine. The output mechanical power of engine is transmitted to the final terminal or blade through a coupling mechanism, shaft tube and gear box. The shaft output of the brush cutter is connected with bevel gear which can be used to remove sugarcane leaf. By replacing brush cutter blade with axial blower which can be used as a blower and vacuum cleaner. When the brush cutter is turned on , the fan starts rotating in anticlockwise direction in the blower. By covering backside of the blower with GI sheet containing vacuum hose , it can be used as vacuum cleaner.

APPLICATION

- 1) It is mostly helpful for small and marginal farmers for gardening works.
- 2) It can be used to remove the leaves of the sugarcane with less effort.
- 3) Blower can used to clean the garden and dry leaves.
- 4) Similarly vacuum cleaner can be used to suck the spilled cereals during harvesting.
- 5) Brush cutter can be attached with multiple attachments as availed in the market.

10.CONCLUSION

Our project entitled design and development of multipurpose brush cutter is successfully completed and the results obtained are satisfactory. It will be easier for people who are going to take the project for the further modifications. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. This project is mostly suitable for small and marginal farmers who cultivates sugarcane. Our project has the facility of having multiple attachments like blower and vacuum cleaner moreover many attachments as available in the market can be attached to the same brush cutter without any risk. By using more techniques, they can be modified and developed according to the applications.

12.REFERENCES

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BLOWER



SUGARCANE LEAF STRIMMER



WORKING MODEL



8. DESIGN CALCULATIONS

1) Brush cutter

Power = 1.3 hp
 Rated rpm = 5000rpm
 Output shaft diameter = 6mm

2) Blower

Outer Casing diameter = 16.5 cm

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