Design and Fabrication of Sugarcane Chipping Cum Planting Machine

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Abstract- *Sugarcane planting is a very labour intensive job and it involves considerable human drudgery. Cost of sugarcane planting by mechanized method is less compared to traditional method. It also reduces drudgery involved in unit operations of sugarcane planting. The reduction in cane yield owing to delayed planting cannot be compensated by additional inputs viz., frequent irrigations, extra fertilizers and intercultural operations. In order to achieve uniform crop stand, correct seed rate, appropriate depth of setts placement and uniformity of setts with required overlapping are important. These, however can better be achieved by using tractor drawn sugarcane cutter planter apart from economizing labour and energy. Thus, recently developed sugarcane cutter planters are getting very good acceptance among sugarcane cultivators. Generally planting of any crop is very much important as far as the crop growth and yield is concerned. This paper describes the design refinement of sugarcane chipper cum planter and its prototype development. This machine simultaneously chips and plants the sugarcane setts into the furrows by pushing it from behind.*

Keywords- Human drudgery, Intercultural operations, Prototype, Sugarcane setts, Cultivators.

I. INTRODUCTION

Sugarcane an important agro industrial crop in India plays a vital role in national economy by contributing 1.9% to GDP. The crop is cultivated in 4.22 million hectare producing 300 tonnes with productivity of 75-80 tonnes per hectare. However, there have been fluctuations in area as well as productivity over the years on a count of several factors. Cutting is the most common method of reproduction in sugarcane. Each cutting must contain at least one bud, and the cuttings are usually planted by hand, the various method of sugarcane planting like flat, trench, pit, staggered row and space transplanting. Hand harvesting accounts for more than half of the world's production, and is especially dominant in the developing world. Sugarcane planting requires about 350 men per hour and 30 to 40 pair of bullocks per hour, per hectare. Mechanization of sugarcane harvesting is an essential input to the modern agriculture as it enhances better productivity, besides using human drudgery and cost of cultivation. Cost of sugarcane cultivation by mechanized process is almost one third of complete manual process. These days sugarcane cultivating farmers are greatly affected by the high production cost of sugarcane cultivation. The high cost involved in the cultivation is generally associated with high labour cost. In addition the yield of the sugarcane is also mainly affected due to the delaying timely planting of sugarcane setts and the error that is caused by planting the setts become a major concern to eradicate these problems which inspired us to innovate a machine which brings solution to all these problems.

II. LITERATURE REVIEW

The concept of the project work is to design and fabricate a machine which performs both chipping cum planting operations simultaneously. For this we referred various research papers regarding the planting techniques and the mechanization which was already developed. By reviewing these papers we came to know that these mechanization majorly depends on non renewable resources for its operation and also involves considerable amount of labours and human drudgery, and we also found that there is no integrated machine for both chipping cum planting operations for sugarcane planting and the both operations are done separately by different machines. So we decided to innovate a machine which integrates both chipping cum planting operations in a single unit. This machine greatly satisfies the demand of the sugarcane cultivators and it also considerably reduces the cost of cultivation and human drudgery involved.

III. DESIGN OF MACHINE

The important factor in manufacturing this machine is to determine the dimension of the linkages and angle between them. The dimension of this machine is preplanned during the designing process by considering the spacing at which the sugarcane setts needs to be planted.

1. Design Calculation

The key design was made to meet the requirements and goals presented in the previous section. Each one of these is related to meeting fundamental requirement. The dimensions of shaft and circular disc (for wheel) should be correct for achieving proper seed rate and accurate placements of sugarcane setts. There are majorly two designs are considered in designing this machine.

A. Designing of shaft

For designing the shaft the method of "Design based on strength is adopted". In this method, design is carried out so that stress at any location of the shaft should not exceed the material yield stress. However no consideration of shaft deflection and shaft twist is included. The bending stress and axial stress are the two major phenomenons which are taken into consideration.

Specifications of shaft used

Material: Mild steel
Outer diameter: 250 mm
Thickness: 5mm

B. Design of circular disc

Torque calculation of circular disc

- Diameter(d) = 300mm
- Thick(t) = 5mm
- RPM(N) = 100
- Let, Y.S. of mild steel(Y) = 250 N/mm
- Allowable shear stress(s) = Y*0.5 = 250*0.5 = 125N/mm
- F.O.S.(F) = 2.5
- Therefore, Allowable shear tress = S/F = 125/2.5 = 50 N/mm

Also, Let polar moment of inertia is "J" and the radius of the shaft "R"(also the maximum distance from center)

Now, the formula of torque is

Torque (T) = (J*S)/R

Now, J = (3.148d^4)/32
= (3.14*300^4)/32
= 794812500 mm^4

Now, substitute all the values,

T = (794812500*50)/150
= 264937500 N-mm

T = 265 KN-m

Now, W = (2*.14*N)/60
= (2*3.14*100)/60
= 10.5 RPS

Now, substituting the values,

P = (265*10.5)
= 2774 KN-m/s
P = 2774 KW

2. Design and drafting

A. AutoCAD

After calculations we drafted 2D sketch of our design with required measurements shown in figure 1.

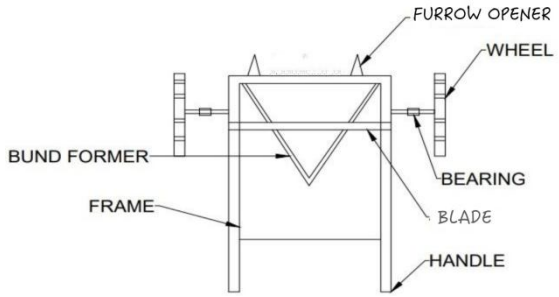

Fig.1 2D Sketch designed in Auto CAD

B. Solid works design:

Realistic 3D model of the machine parts were designed and assembled in Solidworks as shown in the figure 2

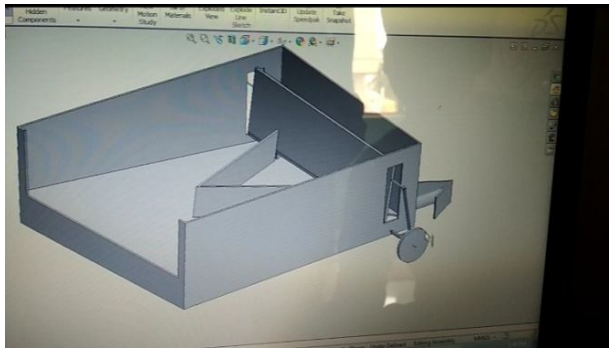

Fig.2 3D Sketch designed in Solidworks

IV. SET-UP AND CONSTRUCTION

Construction details:

Mechanical components:-

1. Sheet metal
2. Crank shaft
3. Shaft
4. Wheel
5. Frame
6. Metal strip
7. Bearing
8. Disk.

V. WORKING

After designing and fabricating the machine parts we assembled those as per the design. We tested its performance at different conditions, which was found satisfactory.

Fig.3 Testing of of machine in the field

Fig.4 Fabricated machine

VI. CONCLUSION

The sugarcane chipping cum planting machine had achieved its goal for which it has been designed and fabricated. Implementing this machine in agriculture works in large scale will surely become a boon to the farmers cultivating sugarcanes.

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