



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemjournal.com

IJCS 2020; 8(4): 239-241

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Received: 05-05-2020

Accepted: 08-06-2020

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International Journal of *Chemical Studies*

Investigation of physical properties of sugarcane stalk for the development of sugarcane detopper cum detrasher

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i4d.9697>

Abstract

Sugarcane is mainly cultivated for sugar production in the world and is an important cash crop of India. It involves less risk and farmers are assured upto some extent about return in adverse condition. In Chhattisgarh sugarcane is cultivated in 0.30 lakh hectare and productivity is 41.6 ton/ha. The physical properties of the plant greatly influences the design of the major unit such as detopping, detrashing, conveyance and blower assembly of the sugarcane detopper cum detrasher. The various physical properties of 5 different varieties (Co-86032, Co-0265, Co-80036, and Co VSI-9805, and Co-085) of sugarcane are measured at farmer's field of Kabirdham district.

Keywords: Sugarcane, detopper, detrasher, detopping, blower

Introduction

Sugarcane cultivation in India is labor intensive process. Farmers mainly depend on human power throughout the season and now a day's scarcity of labor in agriculture sector is major problem. Hence mechanization is considered as an alternative to solve the problem of scarcity of labour. The major areas which require mechanization in sugar cultivation planting, harvesting and detrashing. The main aim of the project is to design a prototype of sugarcane detopper cum detrasher at low price so that it can be affordable to the farmers or group of farmers and that contributes mechanization of harvesting for ensuring cost effectiveness of sugarcane cultivation.

The physical properties of sugarcane play a significant role in designing the major components of sugarcane detopper cum detrasher. Physical properties such as length, diameter, node characteristics, leaf characteristics, amount of trash content of major varieties of sugarcane are measured. These properties are mainly depends on morphology of the sugarcane.

Moore and Nuss (1987) ^[5] reported that the node consists of a growth ring or intercalary meristem, the root band (containing root primordial) and a bud above the leaf scar where the leaf sheath attaches, which delimits the node from the inter node. The transverse cross section through an inter node reveals vascular bundles surrounded by parenchyma cells with a thick outer epidermis covered in an external layer of wax.

Hunsigi (1993) ^[3] reported that the optimum spacing for planting of sugarcane is 0.9 to 1.0m between rows. In subtropical India, where growth of the plant is restricted due to climatic parameters, a row spacing of 0.75m is adopted. Even though there are different planting systems for sugarcane, the ridges and furrows system of planting is very common in South India. The fields at different locations are studied for finding out the existing row spacing of the crop, to decide the optimum spacing of the crop divider and the effective width of the base cutter.

Bull A (2000) ^[2] reported that inter node length can reach over 30cm, depending on growth conditions, and stems normally reach two to three metres in the normal growing season.

Miller and Gilbert A (2009) ^[4] reported that the leaves are usually attached alternately to the nodes, thus forming two ranks on opposite sides. The mature sugarcane plant has an average total upper leaf surface of about 0.5 square metres and the number of green leaves per stalk is around ten, depending on variety and growing conditions.

Bastian, and Shridar, (2014) [1] studied the physical properties of sugarcane pertaining to de-topping, de-trashing and conveyance are studied for the designing of a whole stalk sugarcane harvester. The various physical parameters for the major varieties of sugarcane are measured in the farmers' field. The farmers' grow CO 86032 sugarcane at a row spacing of 75 to 100 cm, and the spacing is increased to 150 and 200 cm wherever harvesting is done by self-propelled combine harvesters. The average number of cane per meter varied from 27 to 30. The length of the millable cane varies between 1200 mm and 2700 mm. The maximum and minimum diameters are 40 and 20 mm respectively. The trash content at the time of harvesting was 38.56 percent where the regular de-trashing processes were completely skipped by farmers.

Materials and Methods

Detrashing is the removal of leaves and tops from harvested cane stalk. The physical properties of the plant influence the detrashing operation, hence physiology of sugarcane plant is very important for the design of sugarcane detrasher. The various physical parameters such as length, diameter, weight, node characteristics, and amount of trash for the major varieties of sugarcane are measured in the farmer's field of Kabirdham district. Also the crop geometry measured in the same field.

Physiology of Sugarcane Plant

Stalk

Stalk is also known as "millable cane". It develops from the bud of seed-cane.

Length of Cane

Length of millable cane in the farmer's field is measured by 5m measuring tape and recorded.

Diameter of Cane

Diameter of sugarcane varies from top to bottom and also depends on varieties. Diameter has an important role in designing detopping unit.

Weight

Weight of sugarcane stalk is one of the important parameter for selection of rollers and blades. The weight of single sugarcane stalk is recorded by digital load cell.

Trash Content

This is one the important parameter for design of sugarcane detopper cum detrasher. Trash content at the time of harvest depends on different varieties and agricultural practice adopted. The trash available at the time of harvest is removed mainly by two operation i.e. detopping and detrashing. The trash content removed by detopping and detrashing is recorded.

Leaf and Node Characteristics

The leaf of sugarcane plant grow alternately on opposite sides of the cane stalk from the node the leaf of sugarcane plant is divided into two parts sheath and blade, separated by a blade joint. The sheath as its name implies, completely sheaths the stalk, extending over at least one complete internode.

Each joint is made up of a node and an internode. The node is where the leaf is attached to the stalk and where the buds and root primordial are found. A leaf scar can be found at the node when the leaf drops off the plant.

Results and discussion

Physical parameters of the sugarcane such as length, diameter and weight of millable cane and nodal characteristics are studied for the design and development of prototype of sugarcane detrasher.

Length of matured cane

Length of 5 different varieties of matured cane such as Co-86032, Co-0265, Co-80036, CoVSI- 9805, and Co-085 are presented in Table 1. Among all the varieties Co-085 has highest average length i.e. 332.3cm.

Diameter

Diameter of the matured cane was measured in the same field. The diameter were measured at three different position viz. top, middle and bottom and presented in Table 2. The diameter of cane varied from top to bottom depends on varieties of the sugarcane.

Weight

Weight of sugarcane stalk varied from variety to variety and agricultural practices adopted by the farmers. The weight of single sugarcane stalk is measured by load cell. Among all the varieties Co 085 has highest 3.3 kg and 86032 has lowest i.e. 2.2 kg.

Node Distance

Node distance of sugarcane stalk depends upon the variety of sugarcane. The node distance were measured at three different position viz. top, middle and bottom and presented in Table 4. were node distance at mid portion is highest as compared to top and bottom.

Trash Content

Trash content at the time of harvest depends upon the variety and agricultural practices adopted by the farmers and were regular detrashing skipped by the farmers of Kabirdham district. The trash content on cane basis were found highest in case of Co265 and lowest in case of Co80036 i.e. 31.1% and 25.5% respectively. Presented in Table 4

Table 1: Length of Different Varieties of Sugarcane

Length (cm)	Co- 86032	Co-80036	Co-265	Covsi-9805	Co-085
Mean	174.2	252.8	270	161.8	332.3
Maximum	198	295	256	265	356
Minimum	139	227	190	149	310

Table 2: Diameter of Different varieties of Sugarcane

Diameter (cm)	Co- 86032	Co-80036	Co-265	Covsi-9805	Co-085
Top	2.67	2.63	2.71	2.76	2.6
Middle	2.89	2.79	2.78	2.91	2.7
Bottom	3.16	3.21	3.12	3.14	3.39

Table 3: Weight of Single Stalk of Sugarcane

Weight (kg)	Co- 86032	Co-80036	Co-265	Covsi-9805	Co-085
Mean	2.2	2.6	3	2.8	3.3
Maximum	2.5	3.1	3.5	3.3	3.8
Minimum	1.8	2.1	2.9	2.3	2.6

Table 4: Node distance of Different varieties of Sugarcane

Diameter (cm)	Co- 86032	Co-80036	Co-265	Covsi-9805	Co-085
Top	9.64	9.21	8.02	9.32	8.83
Middle	12.03	11.05	11.48	11.41	12.08
Bottom	7.08	6.14	7	6.71	6.9

Table 5: Trash content

S. No.	Variety of cane	Total trash on cane basis (%)
1	Co265	31.1
2	Co86032	27.7
3	Co80036	25.5
4	CoVSI9805	28.2
5	Co085	29.7

**Fig 1:** Measurement of physical properties of sugarcane

Conclusion

The study was undertaken to understand the requirement of sugarcane detrasher. The various physical parameters such as length, diameter and weight of millable cane, nodal characteristics and amount of trash content were studied at Kabirdham district. These properties play vital role in the development of sugarcane detopper cum detrasher. Among all the varieties Co-085 has highest average length i.e. 332.3 cm. The diameter of cane varied from top to bottom depends on varieties of the sugarcane. The weight of single sugarcane stalk is measured by load cell. Among all the varieties Co 085 has highest 3.3 kg and 86032 has lowest i.e. 2.2kg. Node distance at mid portion is highest as compared to top and bottom. The trash content on cane basis were found highest in case of Co265 and lowest in case of Co80036 i.e. 31.1% and 25.5% respectively.

Acknowledgement

The first author is thankful to Swami Vivekanand College of Agricultural Engineering and Technology, IGKV Raipur (CG), for providing financial assistance and technical support to conduct the experiment.

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