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RESEARCH ARTICLE

Development of Lever Operated Sugarcane Mother Shoot Cutter for Sustainable Sugarcane Initiative

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ABSTRACT

India has the second highest area under sugarcane cultivation next to Brazil. Sugarcane is cultivated in an area of 4.5 million ha with an average productivity of 79 t/ha. Sustainable Sugarcane Initiative (SSI) is one of the advanced methods of sugarcane cultivation technique that involves, use of less input like seed sett, water, land, labour and optimum utilization of fertilizers to achieve maximum yield. Removal of mother shoot is one of the main techniques of SSI to get even number of tillers, increase the number of tillers and millable canes per plant. Conventional tool like secateurs, knifes and sickles being used among the sugarcane growers, even after experiencing the less efficiency of tool. In addition, more drudgery is involved, because the agricultural labourers need to bend down and hold the stem to remove the mother shoots in each sugarcane plant. Chances of getting injury to the hands and eyes are more during this operation. Hence, a hand operated tool for removing the mother shoot of sugarcane plants was developed and evaluated in sugarcane crop during 30 to 35 days after transplanting. The tool is manual operated and can be operated in standing posture for a long time. Women labourers can also cuts sugarcane mother shoots easily due to low weight (1.6 kg) of the tool. The tool saves cost and time by 47 per cent and 44 per cent, respectively compared to cutting of mother shoots with sickle. One could cut 1200 shoots/h with the tool. The tool costs Rs. 800/- and cost of operation is Rs.465 per hectare.

Keywords: *Sugarcane;Mother shoot;Cutter;Sugarcane tillers*

INTRODUCTION

Sugarcane is grown in more than 115 countries with an average cultivable area of 27 million ha, with a total cane production of 1879 million tonnes and productivity of 71 tonnes/ha. India has the second highest area under sugarcane cultivation, next to Brazil. In India, Sugarcane is cultivated in an area of 4.5 million ha with an average productivity of 79 t/ha. About 7.5 million farmers are dependent on sugarcane cultivation and ancillary activities and 0.5 million workers are engaged in sugar mills in India (Singh *et al.,* 2020; Shukla *et al.,* 2017). In Uttar Pradesh, Maharashtra and Tamil Nadu, sugarcane crop plays a major role in the state economy. In India, sugarcane production has been fluctuating from 233 to 355 million tonnes in last ten years (Thirukumaran and Kavitha, 2020).

The area under sugarcane cultivation is decreasing due to increase in seed and labour costs, soil fertility and productivity related issues. Sustainable Sugarcane Initiative (SSI) is a suitable option to solve these problems. SSI is an innovative method of sugarcane production that involves various operations like, using less seeds, less water, optimal use of fertilizers and land to achieve more cane yields. In addition, removing the mother shoot is one of the main techniques of SSI to get even tillers. The mother shoots cutting involves, cutting plants just 25 mm above the ground level after the establishment of sugarcane seedlings (Biksham *et al*., 2009). This will ensure more number of tillers (Thirukumaran and Kavitha, 2020) and millable canes per plant. (Mani *et al*., 2017).

Conventionally, secateurs, knifes and sickles are being used by the farmers for removing sugarcane mother shoots. Existing conventional tools are not comfortable to be used for long time among our farmers because the agricultural labourers need to bend down, hold the stem and cut the mother shoot of each sugarcane plant. Chances of getting injury to hands and eyes are more during the manual cutting of sugarcane mother shoots using conventional tools (sickle). The presence of sharp spines on the stem and the serrated margin of the leaves or tools increase the vulnerability of the injury. Agricultural labourers get backache during cutting the sugarcane mother shoots. (Kathiresan, 2012)

Since the higher work strain resulted in low productivity; use of human works should be reduced and replaced with the machines (Intranot and Srithongchai, 1993). Labour for cutting sugarcane is becoming constraint because manual cutting of sugarcane mother shoot has been classified as “hard work” (Lyne *et al*., 2007). The problem of labour scarcity is increasing due to urbanization and industrialization. In India, particularly sugarcane cultivation become tedious for want of sufficient labours and ultimately will have an impact on the sugar production in the country.

Studies of the National Agricultural Technology Project on Sugarcane Mechanization on Indian Council of Agricultural Research (ICAR) indicate that sugarcane growers are gradually adopting modern sugarcane machinery for tillage and planting either on ownership or custom hire basis (Yadav, 2007). Under such situation, the present developed tool was tested and demonstrated in the college farm, AEC&RI, Kumulur, Trichy District and farmer's field. The number of sugarcane mother shoots cuts per hour was studied and compared with conventional methods

MATERIAL AND METHODS

The farm tool consists of commercially available secateurs, frame and handles (Figure 1). The secateurs contain one sharp edge and one flat surface pivoted at the distance 60 mm with a rivet. The secateurs open and closes based on the fulcrum principles. A tension spring provided between the handles of the secateurs to restore the original position of the secateurs immediately after use. The cutting edges of secateurs normally kept open and closed during cutting operation. Since the average girth of the sugarcane stem measured was 28 mm, opening of 35 mm gap maintained at the open position of the secateurs. The secateurs was fitted bottom of the mild steel flats so that the cutting is horizontal.

Random samples of 50 male and female workers selected and elbow height from ground level is measured. An average value was workout and utilized for ascertaining the height of handle. The height of 900 mm two flats was made of 12x6 mm mild steel. The flats were fitted such that their position in the shape of 'X'. The MS flats hinged with rivet such that their motion is constrained link in one axis. The flats were riveted at height of 350 mm from the secateurs. At the top of mild steel flats, 160x20 mm mild steel pipe was fitted as handles. The cutting edges of the secateurs closes and cut the mother shoots and the handle were brought to the original position due to action of tension spring fitted in between the handles of secateurs. On top surface of the secateurs, provision made to lock the cutting edges that are not in use. The front, side and top views of the developed farm tool are presented in Figure 2.

The tool was evaluated in sugarcane (Co G (Sc) 5 and CO 86032) fields after 30 to 35 days of planting. Numbers of mother shoot were counted after operating the tool for one hour in each test that was conducted in different districts (Trichy, Cuddalore, Dharmapuri and Coimbatore) of Tamil Nadu. In addition, increased numbers of tillers per plant were registered and cost of operation of the tool was calculated. From the above data, operational cost of the farm tool for removing the sugarcane mother shoots was calculated and compared with conventional (sickle) method. Mean output of the tool was recorded in terms of number of sugarcane mother shoots cut per hour. Three farm laboures were used for conducting

field test in each location. The duration of test was one hour. The test was conducted between 9 am to 1 pm.

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RESULTS AND DISCUSSION

The lever operated sugarcane mother shoot cutter has been developed at Department of Farm Machinery and Power Engineering, Agricultural Engineering and Research institute, Kumulur, Tamilnadu, India with the following specifications.

Secateurs	:	200 x 150 x 35 mm
Mild steel flats	:	900 x 12 x 6 mm
Handle	:	160 x 20 mm
Overall dimensions	:	900 x 510 x 210 mm
Weight	:	1.6 kg

The height of the tool was fixed as 900 mm based on the average value of elbow height of 50 sample workers under the study. The height of the tool plays an important role in decreasing the comfort of the operator without getting fatigue earlier (Gite *et al*., 2009).

Field tests with the developed tool were conducted in six different locations in four districts of Tamil Nadu (Figure 3). The tool was operated in one month aged sugarcane crop for removing of sugarcane shoots (Anbumani *et al*., 2020). Out of six locations of the field tests, two were in Sugarcane Research Stations of Trichy and Cuddalore districts, one in Krishi Vigyan Kendra of Dharmapuri district, one in Tamil Nadu Agricultural University Farm, Coimbatore and two in farmers' fields of Trichy and Dharmapuri districts. Performance tests were conducted with the developed tool and conventional (sickle) method and the output results are shown in figure 4. Thirty farm labourers has been used in the developed tool. After three months of cutting of mother shoots, it was observed that the number of productive tillers was 19, which was higher than the conventional method. It might be cutting of mother shoots after 30 days of planting (Thirukumaran and Kavitha, 2020). The farm labourers worked for long time without fatigue as compared to the conventional method, due to working in standing posture and less weight of the tool.

In comparison, the developed farm tool and conventional tool (sickle) could cut 1200 shoots/h and 671 shoots /h, respectively. The operational cost of developed and conventional tool was Rs. 465 per

hectare and Rs.884 per hectare, respectively. The tool is light in weight, sturdy and suitable for start-up manufacture. The cost of the tool is Rs.800.

CONCLUSION

This developed farm tool is easily portable due to the lightweight to use in standing posture for cutting the mother shoots of sugarcane crop. While cutting the sugarcane mother shoots, injuries caused to the hands and eyes were zero. The tool is strong, women friendly and easy to manufacture. The tool could cut 1200 shoots/h. The tool saved cost and time of 47 per cent and 44 per cent, respectively during the cutting mother shoots.

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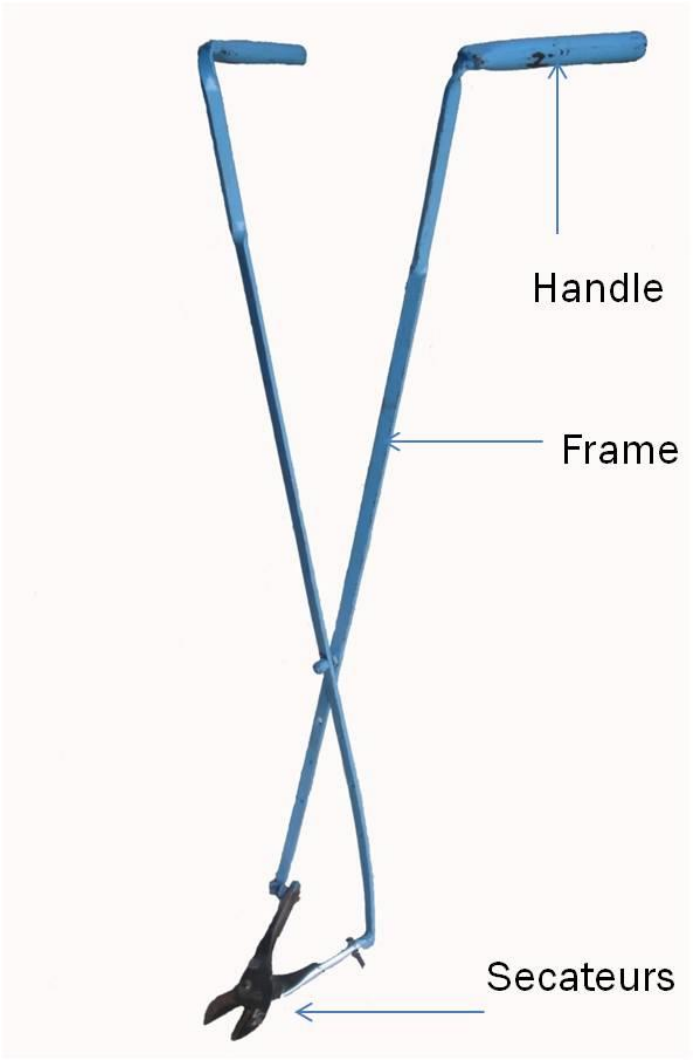

Figure 1. Lever operated sugarcane mother shoot cutter

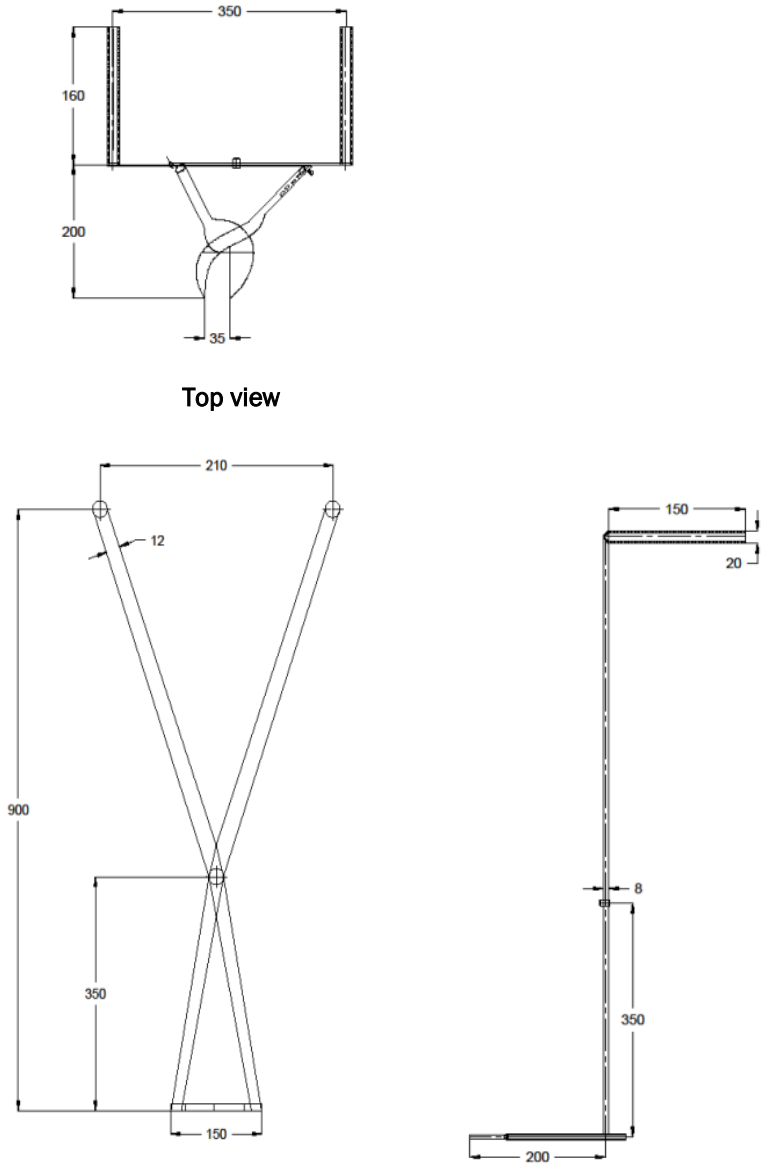

Figure 2. Lever operated sugarcane mother shoot cutter

Figure 3. Demonstration of lever operated sugarcane mother shoot cutter in farmers' fields

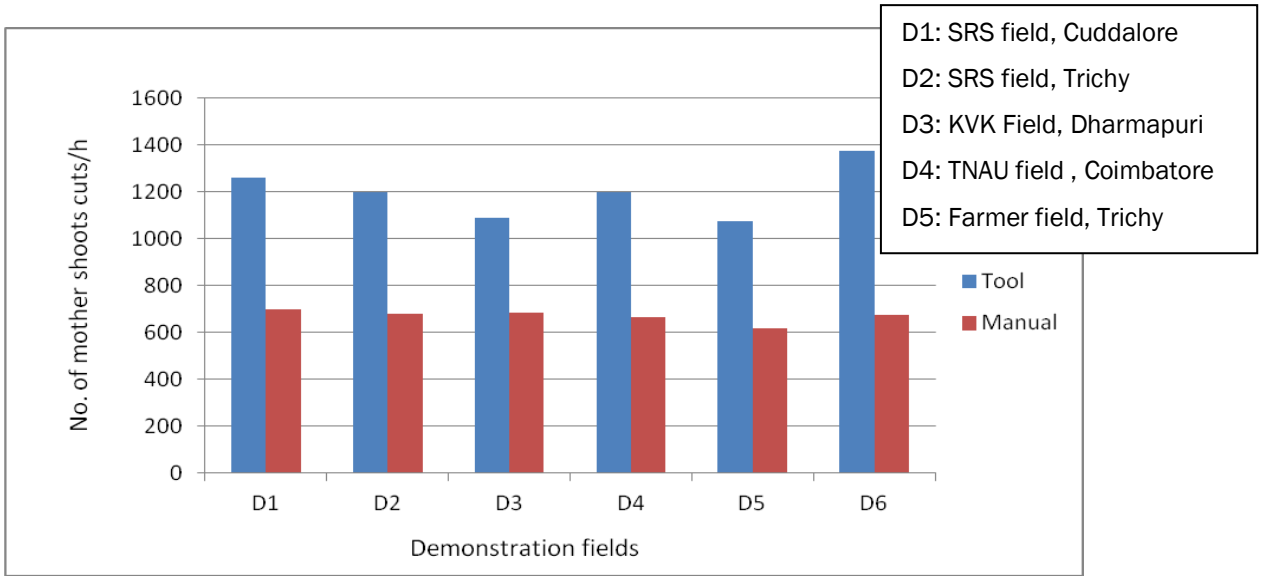

Figure 4. Performance of the lever operated sugarcane mother shoot cutter