

Performance evaluation of machinery for sugarcane handling and trash management

■ S. MUKESH AND VIJAYA RANI

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See end of the Paper for authors' affiliation

Correspondence to :

S. MUKESH

Department of Farm Machinery and Power Engineering, C.C.S. Haryana Agricultural University, HISAR (HARYANA) INDIA

■ **ABSTRACT** : The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development in the rural areas by mobilizing rural resources and generating higher income and employment opportunities. About 7.5 per cent of the rural population, covering about 45 million sugarcane farmers, their dependents and a large number of agricultural labour are involved in sugarcane cultivation, harvesting and ancillary activities. There are about nine States in India where sugarcane is grown on a large extent of area. There are a number of varieties that are grown in India depending on the suitability of the soil. The area, output and yield and sugarcane cultivation is subjected to fluctuate in response to policies of the government and also conditions of cultivation. Sugarcane is a labour intensive crop and shortage of labour and unavailability of labour at reasonable rate is the major concern in sugarcane cultivation. To combat the paucity of labour, mechanized sugarcane cultivation is the only option to carry out all the operations in time. The next phase of revolution in Indian agriculture is bound to come through the use of improved agricultural machinery suiting to local conditions. The performance evaluation of sugarcane handling equipments like tractor front mounted sugarcane loader, tractor operated sugarcane billets collector cum unloader and tractor PTO operated sugarcane trash shredder were conducted at Farm Machinery Testing Centre, CCSHAU, Hisar and the performance has been found to be satisfactory. Concerted efforts are required to formulate a strategy for mechanising sugarcane production in India with the sole aim of increasing production and productivity per unit time, area and input at reduced cost of unit operation to survive in the highly competitive international sugar market.

■ **KEY WORDS** : Machinery, Sugarcane handling, Trash management

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Sugarcane is an important cash crop in India which plays a pivotal role in national economy by contributing 2.0 per cent to GDP. The crop is cultivated in 4.86 mha producing 341 mt with a productivity of 71 t/ha. However, there have been fluctuations in area as well as productivity over the years on account of several factors. Plateauing yield level, declining factor productivity and increasing production

cost in recent years posed serious concerns before cane growers and mill owners.

At present, the level of mechanization is confined to tractorisation only in general and use of land preparation equipments mainly cultivator and harrow in particular (Sharma *et al.*, 2007). In spite of the fact that number of useful equipments have been developed at the Indian Institute of Sugarcane Research, Lucknow,

the adoption level has not been encouraging. Use of improved equipments in accomplishing other operations required in cane cultivation, is almost non-existent. A brief description of performance of some of the newly developed equipments for sugarcane harvest handling and trash management has been given so as to take these labour saving and cost efficient devices to the farmers with a view to sustain sugarcane productivity.

In sugarcane cultivation, disposal of trash in the field after harvesting of sugarcane is a major problem faced by sugarcane growers in India. In conventional method, after harvesting, dried and semi dried cane trash is collected and heaped or spread in the field. The trash is then usually burnt in the field if the farmer does not require it for fuel. The nitrogen content of cane trash is lost to the atmosphere due to burning. The dried trash is simply burnt in the field with the belief that the heat generated, probably eradicates disease causing pathogens and the nutrients of trash are added to the soil in the form of ash. However, trash mulching has proved advantageous in conserving soil moisture, soil protection (against erosion and nutrient leaching), controlling the weeds and especially increasing organic matter and nitrogen fixation

by soil micro-organisms (Patriquin, 1982). Many sugarcane producing countries in the world have obtained higher yields with ratoon crops by application of trash mulching in the cane field after harvesting. Studies by Graham *et al.*, 2005 indicated that mulch retention could improve soil organic matter content and microbial activity. According to Yadav *et al.* (1994) apart from increasing nutrient use efficiency, mulch retention can also improve soil fertility and maintain growth of sugarcane over a longer time.

Possible alternatives to burning of the trash include treating the residue with a chemical adjuvant, reducing the residue particle size by shredding and then incorporating the residue into the soil. Shredding of the trash would make the particle size smaller, increasing the surface area from which microbes could degrade the residue quickly. Soil incorporation of harvest residue would also increase the amount of residue surface that would come in contact with soil microbes and thus should hasten decomposition. Thus, proper management of crop residues for the maintenance of soil fertility is to be stressed for the sustainability of the high crop productivity.

Sugarcane trash shredder is a machine which can

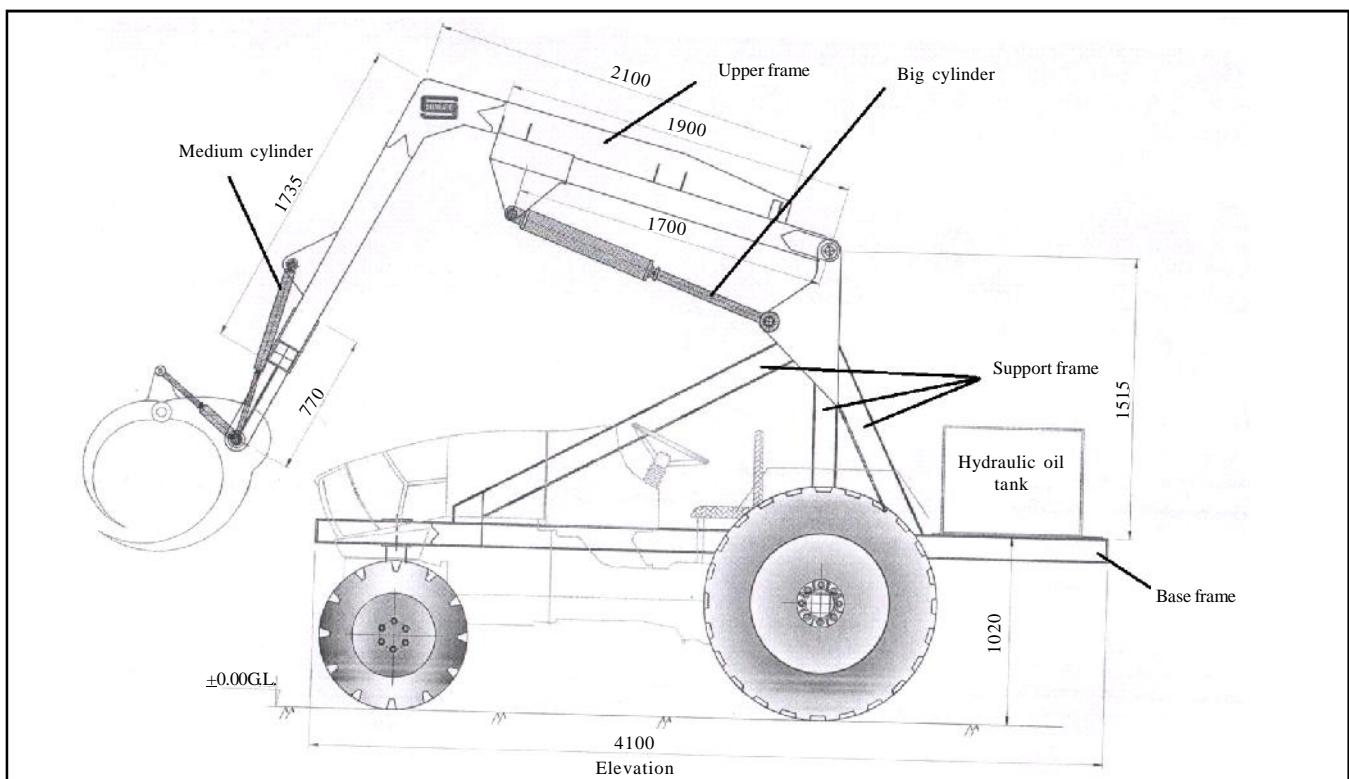


Fig. 1 : Basic details of tractor mounted sugarcane loader

be used for improvement of soil fertility thereby increasing productivity of sugarcane which will finally increase the economic returns of the farmers involved in its cultivation.

In this paper, an attempt has been made to discuss the performance of equipments like tractor mounted sugarcane loader, tractor operated sugarcane billets collector cum unloader and tractor operated sugarcane trash shredder which have been submitted by manufacturers for performance testing at Farm Machinery Testing Centre, CCSHAU, Hisar

Tractor mounted sugarcane loader :

It is tractor front mounted loader used for loading of harvested sugarcane from the field to truck. The base frame consist of M.S. square box which pass through both side of tractor body. The upper body is welded with main frame giving rigid frame. At rear end big hydraulic

ram cylinders are given which give all movement to loader through bush. Loader movement through two ram cylinder is independently controlled by 2/3 way valve which is provided near tractor operator. The weight tank is filled with concrete weight of 150 kg so that front loader does not tend to rotate and jump while working in load and transport position. Driver seat is below triangular M.S. box and covered by transparent sheet for protection of driver as shown Fig. 1. A view of tractor mounted sugarcane loader is given in Fig. 2. The specifications of the machine is given in Table 1.

The sugarcane loader mounted on New Holland 3630 was tested for its performance for 20 hours. The average weight of sugarcane that can be carried by the



Fig. 2 : A view of tractor mounted sugarcane loader

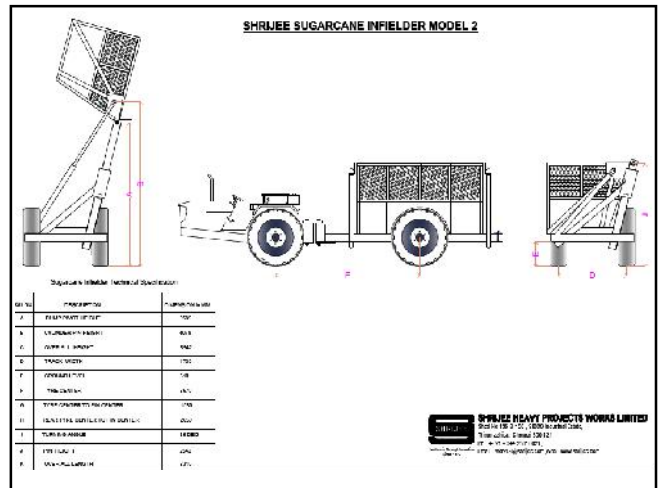


Fig. 3 : Dimensional details of sugarcane billets collector and unloader (infielder)



Fig. 4 : A view of sugarcane billets collector and unloader (infielder)

Table 1 : Specifications of sugarcane loader

Sr. No.	Description	Value
1.	Length	5150 mm
2.	Width	1080 mm
3.	Height	5820 mm
4.	Transport position height	3200 mm
5.	Total weight (with tractor)	4900 mm
6.	Hydraulic oil tank capacity	90 litres
7.	Nominal displacement	31.80
		cm ³ /rev
8.	Flow rate nominal of directional control valve	70 lpm
9.	Hydraulic operating pressure	250 kg/cm ²

sugarcane loader in one operation has been found to be 1010 kg. The average dumping height was observed as 16 feet. The average fuel consumption of tractor was recorded as 4.9 lit./h. The performance of the tractor mounted sugarcane loader is found to be satisfactory without any overloading. The tractor remained stable throughout the operation.

Sugarcane billets collector and unloader (infielder):

Sugarcane billets collector and unloader (infielder) is a tractor hydraulically operated tipping trailer to collect the sugarcane billets delivered by sugarcane harvester and subsequently unload the same in trucks. The trailer is hinged to the rear portion of tractor. The prime mover of machine is a general purpose tractor with front axle and wheel of the tractor removed and the steering system is controlled by tractor rear drive wheels through two hydraulically operated cylinders. A view of the machine is given in Fig. 3. The specifications of the machine is given in Table 2. The dimensional details of sugarcane billets collector cum unloader is given in Fig. 4.

This infielder was operated in field for 29 hrs. during collection of sugarcane billets from the sugarcane harvester and unloading of sugarcane billets. During the test, the billets of sugarcane (Co-806032 variety) were collected in trailer and the field performance with regard to quality of work, rate of work, fuel consumption, safety and soundness of construction etc. were assessed. During the field test the speed of operation varied from 1.94 to 2.88 kmph. The average fuel consumption varied from 1.7 to 1.9 l/h. The fuel consumption per tonne of crop collected varied from 0.14 to 0.16 l/t. Average box filling time was observed as 18 to 22 minutes whereas average un-loading time was recorded as 69 to 78 sec. Average sugarcane billets carrying capacity of infielder varied from 4.20 to 4.36 tonne. The controls provided around the operator are within easy reach. No inconvenience to the operator was observed during field test of infielder. Overall performance in infielder was satisfactory.

Sugarcane trash shredder :

A sugarcane trash shredder (leaf chopper) was tested for its performance in the farmers field. The sugarcane trash shredder (leaf chopper) is a trailed type tractor PTO operated machine as shown in Fig. 5. The machine consists of two units namely aspirator and shredder unit. Aspirator unit lift the sugarcane leaves

from the ground by sucking action and then convey it to shredder attached behind it. The shredder chops the leaves into smaller pieces and spread it on ground behind

Table 2 : Specifications of Sugarcane billets collector and unloader (infielder)

Sr. No.	Description	
1.	Length (with tractor)	8450 mm
2.	Width (with raising box)	2950 mm
3.	Height (in normal position)	2550 mm
4.	Height (in unloading position)	6150 mm
5.	Dumping height	5860 mm
6.	Horizontal hang of box assembly from outer edge of LHS of trailer during dumping position, mm	625 mm
7.	Hydraulic tank capacity	95 litres
8.	Hydraulic pump capacity (2 nos.)	36 lpm
9.	Maximum hydraulic power of pump	10 kW
10.	Pressure at maximum hydraulic power, MPa (kg/cm ²)	16.8 (172)

Table 3 : Brief description of tractor operated sugarcane trash chopper

Sr. No.	Parameters	Specification
1.	Overall dimensions, mm	4100 × 1840 × 1910
2.	Total weight of machine, kg	990
3.	Total cost of machine, Rs.	1,50,000
4.	Power source	Tractor operated
5.	Inlet mechanism	Suction Fan Mechanism (484 rpm at 540 PTO rpm)
6.	Shredding mechanism	Caged cylindrical wheel with knives mounted on eight horizontal bars (13 and 14 alternately) Total knives: 108 Nos. (1188 rpm at 540 PTO rpm)
7.	Drive mechanism	Belt, Pulley and Gear Drive
8.	Dust removal mechanism	Blower fan



Fig. 5 : Sugarcane trash chopper-cum-spreader machine during field operation

the machine. The suction unit has four wings. The wings of aspirator are of arc shape. The wings are welded to vertical shaft which gets power from tractor PTO through gearbox. The wings rotates in horizontal plane in counter clockwise direction. The shredding unit consists of cylindrical drum and counter bars. The cylindrical drum is mounted in transverse direction to direction of travel. The drum consists of eight bars mounted on circular disc. Serrated blades are mounted on these bars at fixed spacing. There are three counter bars which are fixed to upper casing of drum. Serrated blades has been fixed on counter bars facing downward. The shredder gets power from gear box through V-belts and pulleys. A blower is provided on machine to give protection to operator from dust. Brief description of sugarcane trash shredder is given in Table 3.

Field test of sugarcane trash shredder was conducted in Fatehabad district of Haryana. The implement was used for shredding sugarcane leaves (Co-119). The average forward speed was found to be 2.76 to 3.20 kmph. The average fuel consumption was 8.75 to 9.15 l/h with New Holland 3630 tractor (33 kW Max. PTO power). The average field capacity was found to be 0.38 to 0.43 ha/h. The straw load was observed from 9.98 to 10.54 t/ha. The straw lifting efficiency was observed from 85.2 to 92.8 per cent. The average leaf size of sugarcane trash before and after the use of machine was observed from 100 to 175 cm and 8 to 12 cm, respectively. The quality of mulch and spreading of trash was uniform and satisfactory. The uniformity coefficient was from 0.90 to 0.95. The average width of shredding was 1.72 to 1.78 m. Field efficiency of machine was observed from 76.5 to 80.8 per cent.

Conclusion :

To ensure food security and to attain maximum productivity, mechanized cultivation of crops and efficient irrigation systems must be introduced. As today's labour force is reluctant to come forward for agricultural operations in view of the tough nature of the job and low remunerations and also considering the lack of efficiency of manual labour, 'mechanized sugarcane cultivation' is the only answer to increase productivity. A number of useful equipments for sugarcane culture have been developed and demonstrated on a limited scale at different places. There is no doubt these equipments are labour

and cost saving and will definitely make sugarcane cultivation more profitable besides reducing human drudgery. There is a need for concerted efforts by different organisations including sugar industry, State Agricultural Universities, Research Organisations, Cane departments, etc., for popularising these equipments (Singh and Sharma, 2010). Cane Mechanization brings numerous benefits to the sugar industry. It helps cane growers to stabilize their cane yields. It also reduces the cultivation expenses considerably. The profit margins to cane growers improve significantly. And any move that increases the efficiency of this sector will in turn ensure the survival of the industry and make it more competitive in the world market.

Authors' affiliations:

VIJAYA RANI, Department of Farm Machinery and Power Engineering, C.C.S. Haryana Agricultural University, HISAR (HARYANA) INDIA

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