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REVIEW ARTICLE

Mechanization of Sugarcane Cultivation in India

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Abstract Sugarcane is the most important agro-industrial crop next to cotton, which is being cultivated in around 4.50 million hectares area in India. The country has produced more than 355 million tonnes of cane at a national average of 70 tonnes per hectare. In the present context of globalisation, ways and means have to be further evolved to produce more sugar per unit area, time and input in order to keep pace with the population growth while preserving the soil and water resources. The challenges in the millennium can be met effectively by adopting the appropriate mechanical alternatives not only for increasing the productivity but inculcating cost efficiency in sugarcane production system. The farm mechanisation in the context of sugarcane cultivation aims at introducing timeliness of operation, reducing human drudgery and improving overall production efficiency.

Keywords Mechanization · Cultivation · Cutter planter · Raised bed seeder · Pit digger · Harvesting · Ratoon management device

Introduction

Indian agriculture is characterised by small and scattered holdings and sugarcane cultivation is no exception. Sugarcane crop remains in the field for almost a year and right from land preparation to harvesting of the crop and its timely supply to the mill. There is a heavy demand of labour and machinery throughout its crop cycle. Sugarcane accounts for 60–70% of the cost of sugar production and thus has a vital role to make sugar industry a commercially viable venture.

In a true sense, if we look at the prevailing degree of mechanisation, it is observed that so called mechanisation is confined to tractorisation only in general and use of land preparation equipments mainly cultivator and harrow in particular (Sharma et al. 2007). As regards planting of sugarcane, 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. The mechanization of cane planting has been, till recently, confined to the use of tractor drawn ridgers for opening the furrows and the rest of the operations involved in cane planting were done manually. Use of improved equipments in accomplishing other cultural operations required in cane cultivation, is almost non-existent.

A brief description of some of the newly developed equipments for sugarcane cultivation has been given and ways and means have been suggested so as to take these useful labour and cost efficient devices to the farmers with a view to sustain sugarcane productivity.

Mechanisation of Sugarcane Planting

After land preparation, sugarcane planting is the major operation which requires to be mechanised first. This is essential to pave way for mechanising subsequent cultural operations.

Various types of animal drawn and tractor drawn sugarcane planters have been developed and successfully tested and demonstrated at the farmers fields. These planters are drop type planters where whole cane is cut separately

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into three bud setts either manually or by a power operated sett cutting machine. These setts are fed manually and the rest of the operations, such as opening of furrows, application of fertilizer, insecticide and fungicide, giving a soil cover over the setts and compacting the soil cover, are carried out automatically with the help of the planter. Various types of sett type planters, semiautomatic and automatic, have been developed. In case of automatic planters, dropping of sett is also automatic besides other operations involved in cane planting.

With the advent of sugarcane cutter planters on the scene, where cutting of whole cane into setts is also done simultaneously, planting through machine has become a viable proposition. Ridger type/Disc type sugarcane cutter planters have been developed and successfully tested and demonstrated in the farmers fields (Singh and Singh 2006). These planters have now become popular among the cane growers and as a result a number of commercial manufacturers have come forward and taken up the manufacturing of IISR design sugarcane planters on a commercial scale. Presently the latest model of sugarcane planter costs about Rs. 50,000.00. The cost of sugarcane planting with the use of this machine may be reduced by about 60% as compared to conventional system of cane planting (Singh and Sharma 2008). Figure 1 shows IISR Sugarcane Cutter Planter in operation. Timeliness of operation and efficient utilization of critical inputs, such as fertilizer, insecticide and fungicide, is also made possible. Sugarcane planters seem to have a bright future and an important role in managing sustainable sugarcane production.

For planting of sugarcane in furrows and companion crops (wheat, moong, mustard etc.) on the raised bed, a tractor operated raised bed seeder cum sugarcane planter was developed recently (Singh 2008). The equipment in operation has been shown in Fig. 2. It helps in saving the cost of operation by about 60% over conventional system (Singh 2010).

A new planting technique called ring pit method of planting was reported in 1982. The ring pit planting technique was very good from the point of view of increased cane productivity but digging of large number of pits over the entire field was found to be very cumbersome and labour intensive. Therefore, the technique could not be pushed for large scale adoption by the farmers. In order to facilitate the pit digging operation a tractor drawn pit digger was developed at IISR. The developed pit digger was able to dig one pit at a time and have excessive vibrations causing dynamic instability during the operation. In view of the above a new tractor drawn pit digger has been developed at IISR (Sharma and Singh 2007). The equipment could dig two pits simultaneously at a time. The developed equipment was tested and evaluated at IISR farm and is shown in Fig. 3.

Fig. 1 IISR sugarcane cutter planter (ridger type) in operation

Fig. 2 IISR raised bed seeder-cum-cane planter in operation

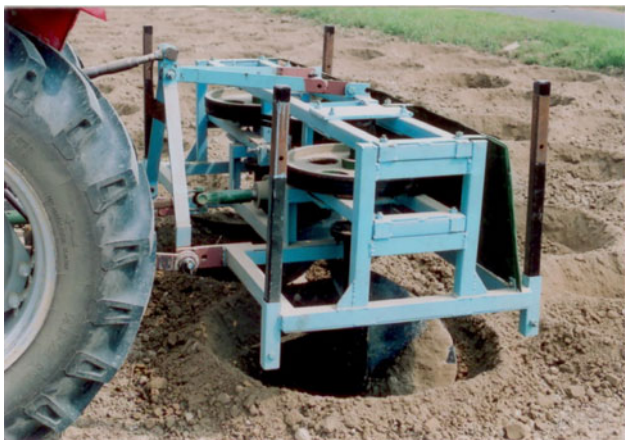

Fig. 3 IISR tractor operated pit digger

Mechanisation of Inter Culture and Earthing Up Operation

About 4–5 inter culture operations are quite common in sugarcane and each operation, if carried out manually,

requires 15–20 man days/ha. Tractor drawn cultivators can effectively be used by adjusting the spacing between the tines as per conventional row spacing. Tractor drawn earthing up devices have also been developed and can be used effectively till the plant growth does not hamper with the operation. Engine operated power weeders have also been developed for inter culture purpose and can be used by the small cane growers.

Mechanisation of Sugarcane Harvesting

Gradually, timely harvesting of sugarcane at affordable cost is becoming a problem particularly in tropical region. Managing a big fleet of labourers to give timely supply of cane to the mill is not easy any more. Under these circumstances, sugar industry is looking for alternate mechanical means for harvesting sugarcane crop at a reasonable wage rate.

In subtropical India, normally, sugarcane harvesting is free of cost in exchange for green tops and as such in near future, the problem does not appear to be of a major concern. Efforts may be made to develop efficient hand tools for harvesting sugarcane crop so as to improve the quality of cutting and output/man/day with reduced energy input. Partial mechanisation seems to be a suitable answer for the time being particularly in subtropical belt (Singh et al. 2010). The available sugarcane harvesting systems can be grouped into:

1. Whole stalk linear windrowing
2. Whole stalk transverse windrowing
3. Whole stalk bundling machine
4. Hand controlled self propelled harvester
5. Chopper type cane harvesters

Whole Stalk Harvesting

Manual Cutting

Proper manual cutting results in minimum loss of cane and the highest quality of the product. The productivity of manual cutters can be improved by giving them proper training, the use of correct cane knife, balance diet, etc.

Mechanical Cutting

Cane cutting attachment for agricultural tractors have been developed. This harvesting system still requires an appreciable amount of labour as cane stalk have to be detrashed, detopped and bundled and subsequently loaded into the wagons. Heavy recumbent cane is difficult to be handled with these aids and dry leaves are removed only partially.

Whole Cane Harvester

More advance machines are now available (CAMECO Harvester), which cut the cane stalk at the base and detop. The cut canes are placed in a single windrow from 4 to 6 rows. Subsequently depending upon the availability of the labour, mechanical loaders/manual loaders can be employed for loading purposes. 8–10% of the trash remain in the harvested cane. At a later stage, use of separate detrashers can be explored for minimizing the level of trash in the cane to be supplied to the mills.

Chopper Type Harvester

With the increasing labour problem, pace of mechanised harvesting may be accelerated and imported models of chopper harvesters may be tried and introduced with the modifications suiting to local needs. Efforts have been initiated in parts of Tamil Nadu and Maharashtra where imported models of chopper harvesters have been tried on a limited scale. There is no doubt that handling of even a heavy tonnage recumbent crop can easily be handled and out put of 25–30 tonnes/field hour can be achieved but trash percentage in the billets (7–8%), small size of the fields, high initial cost of the machine, wider row spacing required (1.5 m) and sophisticated systems are the major constraints in successful adoption of these imported machines under Indian conditions. Delays from harvest to crush further aggravate the problem. Efforts are being made to develop an indigenous model of sugarcane harvester suiting to Indian conditions. A modern combine sugarcane chopper harvester (Austoft 7000) was imported from Australia and field tested (Singh and Singh 2006) in Sakthi Sugars Ltd, Sakthinagar, Tamilnadu (Fig. 4).

Trash Management

In the present scenario where manual harvesting is in vogue, handling of trash is another area requiring attention of the researchers. Researches conducted at other places, have indicated that application of vinasse and filter cake to the residues, promotes decomposition of the dry matter so that resulting compost can be harrowed into the soil within 30 days. Nutrients derived from the trash may include 32 kg N/ha, 6 kg P_2O_5/ha and 30 kg K_2O/ha. At IISR, equipment for in situ incorporation of sugarcane trash has been developed and is under extensive field trials. The equipment is mounted with the tractor and is operated by PTO shaft. The system picks up trash, passes it on to the chopping unit where trash is chopped into small bits which ultimately gets mixed up and buried under the soil with the help of a pair of discs provided at the rear end. Provision

Fig. 4 Modern sugarcane chopper harvester (Austoft 7000) during trials

Fig. 5 IISR trash handling equipment

has also been made for applying chemical/other substances for quick decomposition of trash (Singh and Singh 2006; Singh et al. 2007).

To start with, burning of trash may be avoided in select areas where insect pests are not a major problem and this precious material can be put to effective use either as a mulch to conserve soil moisture or as organic matter, there by improving the soil health. Newly developed equipment is shown in Fig. 5.

Machinery for Ratoon Management

Ratoons play an important role in improving overall economics of sugarcane production. A multipurpose equipment (ratoon management device) has been developed which takes care of the important cultural operations required to be performed for raising a good ratoon crop (Anon 2008a, b). The equipment takes care of (Srivastava 2010);

1. Stubble shaving
2. Deep tilling and off barring

Fig. 6 IISR ratoon management device in field operation

3. Manure/bio-fertilizer and chemical application, and
4. Earthing up

Proper use of this equipment leads to improved ratoon productivity. The equipment in field operation has been shown in Fig. 6.

Futuristic Strategies

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 pieces of 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). All these useful time, labour and cost saving devices can be taken to the farmer fields with the joint efforts of all those involved in the pursuit of increasing sugarcane productivity. Suitable liaison with the implement manufacturing industries be developed and prototypes be fabricated and demonstrated on a large scale in order to create awareness among the farmers. Later on, private entrepreneurs could be encouraged to provide these useful equipments to the farmers on custom hiring service basis.

The next phase of revolution in Indian agriculture is bound to come through the use of improved agricultural machinery suiting to local conditions. 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. This is must if we have to survive in the highly competitive international sugar market.

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