

## Mechanization in Sugarcane: Need of The Hour

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ARTICLE ID: 063

### Introduction

Sugarcane is a long duration perennial crop belongs to the family gramineae. It is cash cum industrial crop takes about 12 months or more for their growth and development so require high number of labour for cultivation. Sugarcane provides employment to the rural people round the year. It is cultivated in an area of Sugarcane area of 5.06 million hectare and production of about 405.42 million tone with average productivity of 80.10 t/ha during 2018-19. The energy consumption in production of sugarcane is higher than the other crops like maize, potato, wheat, rice, etc. The crop requires about 375 man-days/ha for different agronomic practices. Now days, scarcity of labour is more due to industrial development and globalization. Non-availability of labour during peak period of season forces the sugarcane growers to use modern farm implements and machines. Farm mechanization can save the labour and ensures timely operations in sugarcane. Mechanization in sugarcane is limited to the land preparation, planting and to some extent intercultural operations. Harvesting of sugarcane is very difficult and tedious operation including detrashing. Thus, there is a considerable mechanization gap, especially in the area of sugarcane planting, inter-cultural operation, plant protection and Raton management.

Therefore, it is necessary that concentrated efforts be made for adoption, development and popularization of sugarcane machinery for various cultural operations for mechanizing sugarcane cultivation in the country for increasing production and productivity at reduced cost of operation.

### What is the need of Farm Mechanization?

Farm Mechanization's key advantages in sugarcane are to minimise labour demand and facilitate faster operations. It aims to improve the productivity of land labour by improving the protection and comfort of farm labour, and to protect the environment by

enabling specific operations and raising the potential revenue. Efficient machinery helps in timely farm operation, input use efficiency, increasing productivity by about 30 percent. Development and introduction of high capacity, precise, reliable and energy efficient equipment and their judicious use can bring in precision and timeliness in field operations. Taking into account the time, accuracy of field operations, improved input consumption efficiency and productivity per unit, it is important to make sugarcane cultivation at least a semi-mechanized one by developing and promoting machinery such as sugarcane cutter planting machines, intercultural equipment, tractor-mounted sprayers and harvesters available in the region and country. If the initial cost of machinery is high, then it can be hired on co-operative basis.

### **Farm mechanization implements for different operations**

#### **(A) Implements for land preparation in sugarcane**

- **Reversible Mould board Plough**

For a successful crop and better harvest, it helps to level out the soil. It is designed to work for functions such as soil breaking, soil raising, and soil inversion in all forms of soil. Its function is cutting and turning the furrow slice or inversion of soil.

- **Disc plough**

It is a plough, which cuts, turns and in some cases breaks furrow slices by means of separately mounted large steel discs. A disk plough work well in the conditions where mould board plough does not work satisfactory.

- **Chisel plough**

Chisel plough are used to break through and shatter compacted or otherwise impermeable soil layers.

- **Sub-soiler**

The sub-soiler role is to penetrate deeper than the traditional machines and break down the soil layers.

- **Pant- ICAR sub soiler-cum- fertilizer applicator**

This machine is used for breaking of hard sub soil pan upto 0.50 m depth and simultaneously depositing the varying amounts of fertilizers at two different depths. The shallow leading winged times of machine place 80 % of the

recommended dose of fertilizer at  $20\pm 5$  cm depths whereas the central sub-soiling tine places the remaining 20 % fertilizers at  $40\pm 5$  cm depth.

- **Disk harrow**

It is secondary tillage implement. It is suitable for hard ground, full of stalks and grasses. Depending upon the disc arrangements, disc harrow are divided into two classes

- a. Single action
- b. Double action

- **Tractor operated culti-harrow**

This implement was developed by IISR, Lucknow and its function is to cultivate, harrowing and planking in a single pass.

- **Power harrow**

It is suitable for the crops which require deeper tillage like sugarcane, potato and other tuber crops.

- **Ridger**

This implement is used to form ridges in well-tilled soil for sowing row crop seeds and plants. The ridger is also used for forming field or channels, earthing up.

- **Cultivators**

The cultivator performs functions intermediate between plough and the harrow. Weeds removal is the primary objective of cultivator.

- **Rotavator**

Rotavator is used in the preparation of seed beds, weed control, mixing soil, crop residue and manure and soil puddling. The Rotavator is available in various sizes according to the horse power of the tractor. It helps to preserve soil moisture and increases porosity and aeration, which improves cane setts germination and growth of sugarcane.

### **(B) Equipment for sett treatment**

- **Moist hot air seed cane treatment**

The MHAT unit has been developed by IISR, Lucknow and designed to control seed piece transmissible diseases like primary infection of red rot,

smut, grassy shoot, ratoon stunting disease and leaf scald of sugarcane which otherwise pass from one generation to other. It also helps in controlling of the insect, pests like scale, mealy bug, etc.

### **(C) Implements for planting operation**

- **Power operated sugarcane sett cutting machine**

Indian Institute of Sugarcane Research (IISR), Lucknow has developed power operated machine to cut sugarcane setts for planting (Singh and Singh, 2006). Fungicidal treatment of setts is also done simultaneously. Electric motor, diesel engine or tractor is used as a prime mover to operate this machine. In this machine, circular saw blades with sharp and finer teeth are used to cut setts.

- **TNAU sugarcane sett cutting machine**

An electric motor operated sett cutting machine was developed at TNAU, Coimbatore. It is made up of a circular saw directly coupled to an electric motor of 0.5 hp. Through this cutter, 3600 setts can be prepared within an hour by employing 3 individuals.

- **Leveling of land by laser guided leveller**

Traditional land levelling approaches are slow, time consuming and costly. Laser levelling is a user-guided precision levelling technique used in the field using a directed laser beam to achieve very fine levelling with desired grade in the agricultural field. By automatically conducting the cutting and levelling operations, it retains the grade. Both level grade and slope grade (one way or two way) can be achieved with the help of this precision equipment.

- **Pit making machine (single row)**

The productivity of sugarcane can be improved by adopting the pit planting technique. For pit planting, approximately 10,000 pits per ha must be made. It's labour-intensive job. A tractor-operated pit making system, consisting of a revolving PTO tractor-powered auger blade, was developed at IISR, Lucknow, for this purpose (Sharma and Singh, 2007). Sugarcane setts are then planted manually in these pits. The field capacity of the unit is 50-60 pits per hour.

- **Tractor operated pit digger for sugarcane planting (two row)**



For digging holes of 90 cm dia at 150 cm row spacing to a depth of 30 cm, a tractor operated two-row pit digger was designed at TNAU. The unit consists of two helical blade augers of 90 cm dia fitted to a rectangular frame work. The auger rotates in the opposite direction. Approximately 250 to 300 pits may be dug in an hour.

- **Tractor drawn semi –automatic sugarcane planter**

In IISR, Lucknow, this machine was made. It consists of two ridger bodies, placed on the main frame, to create ridges and furrows. A metering funnel is connected where the sugar cane sets are dropped by the operator. A separate box with automatic fertiliser metering system (Singh and Sharma, 2010). One tank is also attached for insecticides / fungicides to be applied through nozzles. A covering device is available for covering the furrows. The planter is a two-row unit and it is operated by 35 hp tractor.

- **Tractor operated semi automatic rotor drum sugarcane planter**

At PAU, Ludhiana this planter was made. This is identical to the model in IISR. The extra feature, however, was the placement of end-to - end setts. In addition to the drop attachment, a rotating drum was given for this purpose to hold setts along the rotating drum until it was lying under the drum in the stationery bottom plate. Cut setts were positioned manually in the rotary magazine.

- **Tractor drawn automatic sugarcane planter**

This implement was established at IISR, Lucknow. In this process, the feeding of setts is carried out mechanically, in addition to other operations, by means of a conveyor chain that transports the settings from the tray to the funnel (Singh and Sharma, 2008). Additional operations such as application of fertiliser and spraying of chemicals can also be undertaken.

- **Tractor drawn ridger type sugarcane cutter planter**

At IISR, Lucknow, this implementing was established. This is a semi-automatic planter designed for all-cane service. Whole cane is fed in place of sugar cane sets. A horizontal blade cuts the sugar cane into sets of 2-3 buds and transports the setts behind the two ridger bodies via a chute (Srivastava,



2010). In addition, fertilizer is metered from fertilizer box through fluted roller mechanism. This implement is suitable for ridge and furrow system of planting. Power for set cutting is obtained from tractor PTO. It saves 80% labour cost and 60% cost of operation compared to conventional method.

- **Tractor drawn disc type cutter planter**

This implement was also developed at IISR, Lucknow, and is similar to the tyne style cutter planter except that the furrow opener style of the disc is used instead of the furrow opener type of the tyne. Like the tyne style cutter planter, this planter also extracts power from the ground wheel to set cutting. This tool is ideal for flat planting. In addition to cutting conditions, application of fertiliser and insecticide are carried out mechanically. Disc type ridger/furrows are suitable for stony, hard soil.

- **Sugarcane bud chipping machine**

Pedal controlled model is suitable for scooping sugarcane bud chips for settle nursery and consists of outer frame, bud chipper to chip the buds, cane holder to carry the cane, pedal to operate the bud chipper, collection basket to collect the chipped buds. A sitting stool is given so that the operator can sit and operate the chipping machine for the bud if necessary. Capacity of the equipment is 550-600 buds/hour. Saving in labour and cost is found to be 78-80 and 85-88% respectively. Saving in labour and cost is found to be 67-68% and 60-62% respectively (Naik *et al.*, 2013).

- **Sugarcane bud-chip settling planter**

The equipment consists of a main frame, connected to a 35-hp tractor standard 3-point hitch. The measuring mechanism, the operator seat, the furrow opener, the soil opener and the soil closure are installed with the required support on the main frame. Two operators may drop the bud chip seedlings from the nursery via the indexing tray rotated by the metering device. The savings in cost was 46.50 %. The breakeven point for the equipment was 41.30 hectare/annum and the payback period was 2.12 years.

#### (D) Implements for Intercultural operations

- **Animal drawn sugarcane earthing up hoe**



It is ideal for loosening the soil between the rows and pushing it toward the earthing up standing plant. It can be controlled by maintaining the spacing between 900 and 1200 mm in the row. It consists of three iron bars with adjustable earthing up wings for the loosening of soil and scraper. It saves 78% of the operating expense. It is suitable for earthing up operation of sugarcane crop having row spacing of 900 to 1200 mm.

- **IISR bullock operated weeder mulcher**

It consists of a spinning reel which is connected to four blades. It is managed by a pair of bullocks. Together with weeds it cuts a 3 cm layer of soil and leaves it in layer above ground. Sometimes when weeds get entangled between the blades, the spinning blades can be raised using a lever.

- **Bullock drawn three-tine cultivator with sweep shovel**

This implement was developed at IISR, Lucknow. This implement, after some modifications has also been commercialized. It is used for inter - cultural practices. Three row bullock drawn cultivators are manufactured commercially in various names in nearly all the country's cities and also by local artisans (Singh *et al.*, 2007).

- **Power weeder, power tiller and mini tractor**

Power tiller is also a multifunctional mechanism used to rotate between crop rows of sugarcane. Most power tillers on the market are available at 10-15 h.p. It is used for weeding and inter-culturing operations. Mini tractors of different brands and designs are available.

- **Fertilizer Band Placement cum Earthing up Machine**

At GBPUAT, Pantnagar the tractor operated (26kW and higher) fertilizer band placement cum earthing up machine was designed and developed. The unit is ideal for the simultaneous placing of fertilizer, earthing up and cutting of weeds in crops with more than 0.50 m row spacing such as corn, sugar cane, potato etc. The application rate of urea fertilizer varies from 60 to 250 kg per hectare. It helps in top dressing of fertilizer at 50 to 100 mm from the plant. The field capacity of machine is 0.56 ha/h with 82.4% field efficiency. There is considerable saving in fertilizer, time and labour over traditional method.

- **Animal drawn sugarcane earthing hoe**

It is an animal drawn implement suitable for the earthing up of sugar cane crops with a row spacing of 900 to 1200 mm. It consists of three loosening bars for the soil and scraper with adjustable earthing wings. At MPKV this implement was developed.

#### **(E) Implements used for Plant Protection**

- **Knapsack, back pack and rocker sprayers and dusters**

Commercially available knapsack, back pack and rocker sprayers and dusters are used by the farmers. These equipments are either hand operated or engine (power) operated. The common problem is less coverage of area while using these types of sprayers.

- **High clearance sprayers and wide swath boom sprayer**

High clearance sprayers and large swath boom sprayers are implemented progressively in different crops and are more economical in comparison with other plant protection measures. The sprayers for high clearance are self-propelled systems. The boom sprayers are either driven by tractors or power tillers or bullocks. The high clearance self-propelled sprayer is powered by 20 hp diesel engine.

- **Solar powered manual sprayer**

In order to spray herbicide / fungicide on various crops, a solar powered manual sprayer has been developed. The height of the spray can be changed from 300 mm to 1000 mm. Preliminary testing of this sprayer for pre-emergence herbicide spraying in sugarcane has been conducted at the Institute Farm.

#### **(F) Equipments and Machinery for Harvesting**

- **Manual cane harvesting knife (IISR design)**

A cane knife has been developed by IISR Lucknow. In Western Uttar Pradesh & Meerut, this manual cane harvester is similar to the common (Pankati) cane knife. Some modifications have been introduced into the IISR knife in effort to reduce human fatigue, retaining the basic characteristics of Pankati. It





consists of a blade mounted onto a curved handle of wood. The bending of the operator is the minimum result during cane cutting.

- **IISR Manual detrasher**

To clear dry trash from standing as well as harvested cane crop, a manual detrasher is used. It has three fingers (20-30 cm long) that are placed with the handle at an angle of 15-200. The long handle is removed when operating in the standing crop. 13 persons will cover 1 ha of field in a day with the aid of this method.

- **IISR Sugarcane detrasher cum detopper**

IISR has developed a hand tool for delaying and de-stopping, which performs the job of efficiently stripping dry leaves and cutting the green top. It is made up of a pair of tongs, the jaws of which form a square nearby and stretch beyond the square to form a "v" in front. One of the two limbs is bent down and a wooden handle is supplied. A light tension spring holds the jaws closed. A knife is welded on the stem of the detrasher for detopping the cane after harvest. The cane is grasped between the jaws of the tool and pulled downwards. The stripper extracts the dry / green leaves by then removing them from the cane stalk and moving them away. On the stem of the stripper, the green top is then cut with a knife supplied for this purpose.

- **Equipments used for sampling of juice (IISR Cane juice sampler)**

This sampler is used to draw samples of composite juice from standing cane crops to determine the maturity of the crop. The sampler consists of an aluminium handle, machined to be taken as a needle of stainless steel and a capsule of glass. The needle is locked at with a grub screw in place on the shaft. It has a cutting edge that when forced through a cane stalk neatly severs the fibres. The juice from the puncture runs down the groove in the middle of the needle and collects in the capsule. A rubber seal provides a leak proof seat for the capsule which is held in position by a cap made of polyethylene.

**(G) Implements for ratoon management in sugarcane**

- **Multi-purpose stubble shaver**



A two-row, multi-purpose stubble shaver driven by a tractor was developed at IISR. In one go, the machinery performs stubble shaving, off-baring and intercultural operations and application of fertiliser. After the sugarcane crop has been harvested, crop residues are left in the field. Multi-purpose stubble shaver is typically used for crop residue management.

- **Ratoon management device (RMD)**

Indian Institute of Sugarcane Research (IISR) has developed RMD. This implement performs all operations such as stubble shaving, off-baring, deep tillage, fertilizer, manure chemical application, intercultural practices and soil covering in its single pass. The equipment consists of sub units are as follows:

1. Stubble shaving unit
2. Off-barring and deep tillage unit
3. Manure, fertilizers and chemical dispersing unit
4. Earthing up unit

- **Disc type Ratoon Management Device**

In a widely spaced sugar cane crop, this machine performs stubble shaving, off-baring and fertiliser application. It occupies a single row and is added on both sides of the row with fertilizer. Without disrupting the trash used for trash mulching, subsequent fertiliser application could be accomplished.

#### **(H). Trash management machines for sugarcane**

- **IISR Plant Residue Shredder**

At IISR, sugarcane trash management equipment has been developed and is undergoing comprehensive field trials. The machinery is fitted with the tractor, and the PTO shaft works. The machine gathers waste and moves it on to the chopping unit where tiny pieces of waste are chopped. Provision was also made for the application of chemical solutions for the rapid decomposition of waste.

- **Sugarcane trash shredder**

Sugarcane trash shredder (leaf chopper) which is a trailed type tractor PTO machine controlled consists of two units namely aspirator and shredder.

Aspirator device raise the leaves of the sugarcane from the ground by sucking



action and then transfer it to the shredder attached behind it. The shredder chops the leaves and spreads them on the ground behind the unit into smaller pieces. The suction unit has four wings. The wings of aspirator are of arc shape. The wings rotate in horizontal plane in counter clockwise direction. The shredding unit consists of cylindrical drum and counter bars.

### **Constraints in farm mechanization**

1. Small and marginal holdings of land.
2. Lack of information on modern equipment and technology.
3. Higher prices for machinery and supplies.
4. Sugarcane growers 'and farmers' bad economic conditions.
5. Lack of facilities for repair, maintenance and substitution in remote areas.
6. Single running basic machine is only available.

### **Future strategies of farm mechanization**

The technology of the mechanisation package must be environmentally sustainable, user-friendly, hazardous operations in a safe and comfortable manner, increase efficiency and promote custom hiring / contract farming. Low purchasing power, low literacy and resistance to change from the conventional system, insufficient credit facilities and weak risk bearing ability are some of the socio-economic constraints in sugarcane mechanization.

### **Conclusion**

The mechanization of sugar cane could go a long way, not only in increasing production, but also in improving the quality of rural work. Clubbed mechanisation technology with effective mechanisation strategy will help to achieve the target of sugarcane productivity. Considering the facts that the mechanisation of sugarcane crops will address ever-increasing scarcity issues like scarcity of labour, cost of cultivation, drudgery and timely completion of cultural operations. So, mechanization in sugarcane is very important for sugarcane growers, sugar mills traders, etc.

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