IISR TRACTOR MOUNTED SUGARCANE MULTIPURPOSE EQUIPMENT

A Success Story

All India Co-ordinated Research Project on

FARM IMPLEMENTS AND MACHINERY

Central Institute of Agricultural Engineering

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Introduction

India stands second in sugarcane production in the world next to Brazil. It is estimated that sugarcane is grown on about 4.076 million hectares (M ha) with an approximate production of 295.72 million tonnes of cane with an average yield of 73 tonnes/ha.

Uttar Pradesh contributes over 50 percent of the total area under cane followed by Maharashtra which covers about 12 per cent. Sugarcane planting is a tedious, labour intensive and time consuming operation. It includes (i) opening of furrows (ii) cutting of cane into pieces (setts), (iii) transportation of setts to field and placing them in the furrows, (iv) application of fertilizer and insecticides in the furrows, (v) covering the setts with soil and (vi) providing light compaction to soil to conserve soil and sett moisture.

Indian Institute of Sugarcane Research, Lucknow has developed various types of sugarcane planters. Semi-automatic, automatic and then sugarcane-cutter-planter were developed. Sugarcane cutter planter performs the work of sett cutting also and is the most accepted model. There are three models of cutter planter and can be classified as (i) ground wheel or tractor pto driven (ii) ridger type or disc type and (iii) roller feed type or hand-support-gravity-feed type.

A tractor mounted multipurpose sugarcane planter has been developed at IISR, Lucknow. This is an improved version of sugarcane cutter planter. The planter can be used for many other sugarcane/agricultural operations.

Traditional practice of sugarcane planting

Farmers prepare the field very well by using disc harrows and cultivators. Tractor drawn ridgers are used to open furrows. Furrow to furrow spacing of 75 cm is most common. Labourers are employed to cut the sugarcane into three budded pieces, which is called setts. Fifty to sixty quintals of cane is required to meet the seed (setts) requirement for one hectare. The huge amount of setts are transported to field and then manually dropped in the furrows. Normally 2-3 cm overlapping is maintained. Fertilizer and insecticide are also dispensed in the furrows, manually. Then setts are covered with soil either manually or by *desi* plough. Planking is done to conserve soil and sett moisture. Besides land preparation, all other operations require 50-60 man-days and 4-5 tractor hours. A farmer has to spend Rs 4000 - Rs 4500/- for planting of sugarcane in one hectare. Cost of land preparation, seed, fertilizer and insecticide are excluded.

Salient features of the machine developed

Brief description of its design features and improvements over existing models of sugarcane-cutter-planters are as below.

i) It is a tractor mounted type planter
ii) It has ground wheel driven cutting and fertilizer metering units.
iii) Ground wheels have been designed in such a way that clogging of lugs is minimum
iv) Furrow openers - the planter has two-way mould board shaped furrower to open the furrows.
v) Cane feeding mechanism - One slanting chute, (55° to horizontal plane) has been provided. The operator has just to put the cane in the chute. Cane slides down by gravity. Theoretically, length of setts will remain uniform provided the forward speed of tractor is less than 3 km/h.

vi) Cane cutting knife - Curved blades (convex shaped) are used to cut the cane at 65°. While cutting, cane remain static and knives rotate. Thus, there is smooth sharp cut through shearing.

vii) Liquid tank - A horizontal PVC pipe of 15 cm diameter has been provided as a tank to avoid rusting and minimize variation in chemical application rate. Nozzle are fitted in the tank. Liquid is directly applied over the setts, in the furrows.

viii) Power drive system - It is simple and repair/maintenance is minimum and highly reliable and rugged.

ix) Weight and weight transfer - It is a three row planter and can be drawn by any 26 kW tractor without adding weight to front portion of tractor.

x) Cost - Due to low weight and simplified power transmission system, cost of 3-row multi purpose planter is highly affordable

xi) Capacity - It's field capacity is about 20% higher than that of two-row sugarcane-cutter-planter

Functions

Planting of sugarcane

It is an improved version of sugarcane cutter planter (Fig.1). Planting of sugarcane is carried out in three rows simultaneously. Planting includes opening of furrows, cutting of setts and placing the setts in furrow, placement of fertilizer and chemicals, covering the setts with soil and providing light compaction.

Tiller

To provide soil cover to setts in furrows, two cultivator tynes with reversible shovels are provided to each row. Hence, total six cultivator tynes with shovels are already available with the planter. With the help of three more additional tynes with shovels, the equipment may be used as nine tyne tiller.

Intercultural equipment
Nine tynes with shovels are arranged in three groups enabling intercultural operations in sugarcane field (Fig.1).

Earthing-up
Furrowers are designed to serve earthing-up operation.

Seed drill
IISR TD Multipurpose sugarcane planter could be used as seed drill, with suitable attachment (Fig. 2).

Paddy puddler
A lug wheel puddler has been developed as an attachment which can be fixed underneath the main frame of the planter. Leveling is also carried out simultaneously (Fig. 3).

Fig.1 IISR Multipurpose planter in operation (Interculture mode)

Fig. 2. IISR Multipurpose planter in operation (Seed drill mode)

Fig. 3 IISR Multipurpose planter in operation (Puddler mode)

Field evaluation

The multipurpose sugarcane planter has been evaluated in large area for different operations. Summary of area covered at IISR farm and on farmers' field is given below.

Operation	IISR Farm (ha)	Farmer's Field (ha)
Sugarcane cutter planter	20	20
Interculture in cane field	125	5
Earthing in cane field	20	1
Puddling	12	10
Wheat drilling	1	-

Field performance data and cost economics

The field performance data in brief for various operations are as below:

Planter mode

i)	Forward speed	..	2.3 km/h
ii)	Row to row spacing	..	75 cm
iii)	Effective field capacity	..	0.3 ha/h
iv)	Field efficiency	..	58%
v)	No. of persons needed	..	5
vi)	Seed rate	..	60 q/ha
vii)	Depth of planting	..	12.0 cm
viii)	Soil cover	..	9.0 cm
ix)	Average length of setts	..	34.4 cm
x)	Head land requirement	..	3.5 m

Economics

Per hectare

Equipment	Tractor/Bullock		Labour		Bullock hiring charges, Rs/pair/ day	Total Cost, Rs
	Hours	Cost, Rs	Hours	Cost, Rs		
Tractor drawn multipurpose planter (3-row)	3.3	583	16.65	124.87	-	708
Convent-ional	2.0	350	472	3060	160	3570

Interculture mode

i)	Head land requirement	..	3.5 m
ii)	Moisture content, % (db)	..	16%
iii)	Width of coverage in one row	..	57 cm
iv)	Total width of coverage	..	2.25 m
v)	Forward speed	..	4.2 km/h
vi)	Field efficiency	..	80%
vii)	Cane damage	..	3.25%
viii)	Ground clearance	..	45.5 cm

Economics

per hectare

Equipment	Tractor/Bullock		Total Cost, Rs
	Hours	Cost, Rs	
TD multipurpose planter (3-row)	1.22	214	214
Desi plough	12.69	254	254

Earthing mode

i)	Head land requirement	..	3.5 m
ii)	Moisture content (db)	..	19%
iii)	Total width of coverage	..	225 cm
iv)	Forward speed	..	3.99 km/h
v)	Actual field capacity	..	0.66 ha/h
vi)	Cane formation height	..	40-45 cm
vii)	Cane damage	..	0.5%
viii)	Height of ridge from GL	..	15 cm
ix)	Depth of furrow from GL	..	16 cm
x)	Width of bund		
	At top	..	20 cm
	At bottom	..	56 cm
xi)	Ground clearance of the equipment	..	57 cm

Economics

per hectare

Equipment	Tractor/Bullock		Labour		Total Cost, Rs
	Hours	Cost, Rs	Hour	Cost, Rs	
Tractor drawn multipurpose planter (3-row)	1.51	264	-	-	264
Bullock drawn ridger	11	220	11	83	303

Puddler mode

i)	Depth of standing water	..	6 cm
ii)	Forward speed	..	4.97 km/h
iii)	Time taken to cover 1 ha	..	1 h
iv)	Puddle depth (after 2 operations)	..	2.3 cm

v)	Depth of puddling :		
	First operation	..	8 cm
	Second operation	..	9 cm
vi)	Lab. Depth of puddle		
	M.P.E. First operation	..	0.9 cm
	Second operation	..	2.1 cm
	Commercial First operation	..	0.7 cm
	Second operation	..	1.9 cm
vii)	Cost of operation	..	Rs 499.00/ha

Seed drill mode

i)	Forward speed	..	3.5 km/h
ii)	No. of rows	..	10
iii)	Row spacing	..	20 cm
iv)	Depth of drilling	..	3 cm
v)	Soil cover	..	Approx. 3 cm
vi)	Seed rate	..	100 kg/ha
vii)	Field capacity	..	0.63 ha/h
viii)	Field efficiency	..	90%
ix)	Soil moisture content (db)	..	16%
x)	Cost of operation	..	Rs 278.00/ha

Specifications

Type	Tractor mounted
Power requirement	Tractor, 26 kW
Size (lxwxh), mm	2200x1460x2050
Weight, kg	347
Frame	MS square pipe section 47x47x3 mm
Number of furrow openers	Three Spacing 750 mm with provision for changing depth of planting as well as row spacing
Type of furrow openers	Two way mould board shaped
Sett metering device	Length of sett is fixed 37 cm (may be varied if required). Convex shaped rotary blades cut setts
Seed/Fertilizer metering device	External fluted feed rollers of die casted aluminum, No. of flutes = 8
Chemical dispensing device	150 mm diameter PVC pipe of 2000 mm length is used as storage tank. Three brass nozzles are fitted in for application of chemical
Transmission system	Cane cutting unit, bevel gear 18:10, fertilizer/seed metering unit, chain sprocket 36:16

Ground drive wheel, mm	Two ground wheels made of 12x12 mm square section are fitted on main shaft Diameter .. 760 mm Width .. 130 mm No. of lugs .. 48 Lug height .. 50 mm Pair of lugs .. 24 Lug angle .. 450 Lug design .. Tractor rear tyre type but in reverse direction
Unit cost, Rs	32,000/-

Present status of the technology

The multi-purpose planter has been taken up for manufacture by three manufacturers. Ten units have been manufactured.

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Unit cost, Rs	32,000/-

Present status of the technology

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Appendix-II

List of manufacturers

1. M/s Sunlight Foundary,
   Lucknow Road,
   Barabanki-225 001

2. M/s Vidyut Yantralaya,
   82, Hazaratganj,
   Lucknow-226 001

3. Head, Agricultural Engineering Division,
   IISR, 9th km Rae Bareli Road,
   Lucknow-226 002.

..... A Step Towards Farm Mechanization

Substenance of a desirable level of agricultural productivity goes hand in hand with mechanization of different farm operations, which aims at achieving timeliness of operations, efficient use of inputs, improvement in quality of produce and safety and comfort of farmers and reduction in loss of produce and drudgery of farmers.

The All India Coordinated Research Project (AICRP) on Farm Implements and Machinery (FIM) with its 28 centres in different parts of the country, has been endeavouring to develop, test and popularize need based farm implements and machinery for different regions. The research and development activity under AICRP on FIM involves design, development, testing and design refinement of farm implements and machinery. Prototype manufacturing activity is for multiplication of research prototypes for multilocation trials, development of manufacturing technology for new machines and promoting their manufacture by involving local manufacturers. Prototype feasibility testing activity of a Centre includes identification of farm mechanization needs under local agro-climatic conditions and identification and adaptation of machines to fill the identified mechanization gaps through their feasibility trials.

One-hundred-seventy-eight farm implements and machinery have been designed and developed under the AICRP on FIM. Ninety-one of these have been commercialized. This publication is one among the series of such publications being brought out by the Project on successful technologies.

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