

Development and Performance Evaluation of Tractor Operated Sugarcane Transplanter

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Abstract

Presently, the sugarcane transplanting operation is adopted by the farmers. They use nursery raised sugarcane seedlings of 45 to 50 days old for transplanting. Sugarcane seedling transplanting is presently done manually which is a labour intensive operation. In view of this, need is felt by the sugarcane growers to develop tractor operated sugarcane transplanter which will be useful for sugarcane seedling transplanting mechanically. Accordingly the project was carried out to design and fabricate sugarcane planting machine for sugarcane plantation to reduce farmer's effort and to increase production of agricultural products. The field trials were conducted at various places including Central Sugarcane Research Center, Padegaon, Satara. The field trials indicated satisfactory performance of the machine. The application of transplanting technique to replace traditional planting of sugarcane saves up two months of the crop production season. The field trials revealed that the average effective field capacity of the machine was 0.20 ha h⁻¹ with 85.15% field efficiency. Net saving over conventional method was worked out to be Rs 1892.00 ha⁻¹.

Key words : Sugarcane transplanter, sugarcane mechanization, sugarcane cultivation.

In India, sugarcane is the most important commercial crop which is grown over 2.57% of its gross cropped area. Globally India is the second largest producer of sugarcane after Brazil and accounts for about 25% of the world's production. It has engaged around 7.5% of the country's rural population in sugarcane farming. Maharashtra is the second largest sugarcane growing state in the country. It contributed 0.58 million hectares (13.53%) to total area and 45.78 million tonnes (15.06%) to total production of sugarcane in the country. The potential of Maharashtra has been shown by the steady growth in area and production over the years. However, the unceasing decline in productivity in recent decades is a cause of great concern. Sugarcane is also the second most important cash crop covering less than three per cent of the total cropped area of the state.

Sugarcane is a vegetative propagated Crop. In India, for conventional system of sugarcane

cultivation, about 6 – 8 tones seed cane ha⁻¹ is used as planting material, which comprises of about 32,000 stalk pieces having 2-3 buds. Cane cuttings with one, two or three buds known as sets are used as seed. In conventional method of planting sugarcane sets are planted manually in furrows, opened manually followed by conveying manually. This is then covered manually or by animal operated planters. Thus, the process is very much time consuming and labour intensive. Sugarcane transplanting technique has been recommended to achieve advantages which are necessary for Indian agriculture. Presently, the sugarcane transplanting operation is adopted by the farmers. They use nursery raised sugarcane seedlings of 45 to 50 days old for transplanting. Sugarcane seedling transplanting is presently done manually which is a labour intensive operation. Umesh S. Patkar, Rajesh W. Lanjewar presented the planting, cultivation and harvesting of sugarcane is highly energy, time

and labour intensive. Suitable techniques, systems and implements have therefore to be developed to minimize the above. H.A. Abd El Mawla, B. Hemida, W.A. Mahmoud investigated transplanting technique has been applied in several countries for reducing the duration of sugarcane production season. The technique also achieves several advantages such as saving seed quantity, labor power and total costs of sugarcane production. In view of this, need is felt by the sugarcane growers to develop tractor operated sugarcane transplanter which will be useful for sugarcane seedling transplanting mechanically. Accordingly the project was carried out to design and fabricate sugarcane planting machine for sugarcane plantation to reduce farmer's effort and to increase production of agricultural products.

The field trials were conducted at various places including Central Sugarcane Research Center, Padegaon, Satara. The field trials indicated satisfactory performance of the machine. The application of transplanting technique to replace traditional planting of sugarcane saves up two months of the crop production season.

Materials and Method

Preparation of Sugarcane Bud Chips :

Nine months old Co265 variety of sugarcane grown in the experimental research plot of Mahatma Phule Krishi Vidyapeeth, Rahuri (MS) was used for investigations. Sugarcane buds were taken from the bottom 1m portion of healthy cane, free from insects and diseases attack were taken out by using sugarcane bud chipping equipment developed by AICRP on Farm Implement and Machinery, MPKV, Rahuri(MS).

Development of tractor operated Sugarcane transplanter : The tractor operated sugarcane transplanter for Sugarcane

Settlings raised from Sugarcane bud chips was developed at AICRP on Farm Implements and Machinery, MPKV, Rahuri.

Theoretical design considerations :

- i. The setts should be of 9 to 10 months and with fully developed eye buds.
- ii. The setts should be free from pests and diseases. If not, proper treatment of fungicide to the setts should be done.
- iii. There should not be any damage to the setts during cutting and subsequent planting.
- iv. The setts should be selected from planted cane and never from ratoon cane
- v. The material used for various components of the machine should be of proper strength, durability and should perform intended functions with ease.
- vi. The machine should be simple in design and easy to repair with minimum maintenance.

The different parts and specifications of the sugarcane planter are given below.

Table 1. Specifications of the tractor operated sugarcane transplanter

Frame :	
Length, mm	: 2560
Width, mm	: 250
Height, mm	: 650
Seedling Metering Mechanism :	
Type	: Horizontally Revolving
Cup Type	
No. of Cups	: 8
Size, mm	: Ø 83 × 345
Type of Opening	: Spring loaded Cam Type
No. of Metering Mechanism	: Two
Furrow Opener :	
Type	: Shoe Type
Material	: High Carbon Steel
Size ,mm	: 505 x 125 x 350
No. of Furrow Openers	: Two

Table 1. Contd.**Soil Covering Device :**

Type	: Pressing Wheel
Size, mm	: Ø 515 × 60
No. of pressing wheels	: Two For Each Covering
No. of Soil Covering Device	: Two
Ground Wheel:	
Type	: Pneumatic tyre
Size, mm	: 5.00 X 12 , 8 Ply
No. of Wheels	: Two

Main Shaft :

Material	: Mild Steel
Size, mm	: Ø 25 X 2300
Transmission System :	
Primary System	: Chain and Sprocket drive
Reduction Ratio	: 1:
Secondary System	: Bevel Gear Box
Reduction Ratio	: 1:

Seating arrangement :

Type	: Fix Seat
Material	: PVC
Size	: Standard
No. of Seats	: Two

Marker :

Material	: Mild Steel
No. of Markers	: Two
Marking Adjustments, mm	: 900 to 1800

Foot Rest :

Material	: Mild steel
Size, mm	: Ø 25 x 300

Seedling Storage Tray :

Material	: Mild Steel
Size, mm	: 2450 x 615 x 65
No. of Trays	: One

Overall Dimensions, (mm):

Length, mm	: 2560
Width, mm	: 1800
Height, mm	: 1450
Mass of the Implement, (kg)	: 450

of 1500mm and average operating depth 149.33mm. The field trials revealed that the average effective field capacity of the machine was 0.20 ha h⁻¹ with 78.37% field efficiency. Net saving over conventional method was worked out to be Rs 2920.00 ha⁻¹. The details of the trials are given in Table 2.

Table 2. Test data of tractor operated Sugarcane transplanter (MPKV) during 2015-2016

Particulars	Test-I	Test-II	Test-III	Average
Date of test	01-10-2015	28-12-2015	20-07-2016	-
Area covered, 2.00 ha		01.00	01.50	04.50 (T)
Crop and Variety,	Sugarcane (C0-265)	Sugarcane (C0-265)	Sugarcane (C0-265)	-
Seedlings transplanted, No. ha-1	11100 (One tray consists of 60 nos. of seedlings. Total 184 trays were required)	11110 (One tray consists of 60 nos. of seedlings. Total 184 trays were required)	11110 (One tray consists of 60 nos. of seedlings. Total 184 trays were required)	11110
Average plant to plant spacing, mm	600	595	595	596.66
Row to row spacing, mm	1500	1500	1500	1500
Germination, %	95.00	96.00	98.00	96.33
Travel speed, Km h-1	2.55	2.58	2.50	2.54
Working width, mm	1500	1500	1500	1500
Operating depth, mm	150	148	150	149.33
Effective field capacity, ha h-1	0.30	0.31	0.28	0.29
Theoretical field capacity, ha h-1	0.38	0.36	0.39	0.37
Field efficiency, %	78.94	86.11	71.75	78.37
Operating cost, Rs h-1	600.00	595.80	613.80	603.20

Result and Discussion

The result obtained from the field performance showed that the forward speed of the tractor was 2.54 Km h⁻¹ with working width

Table 2. Contd.

Operating cost, Rs ha ⁻¹ ,	2000.00	1922.00	2192.00	2080.00
Operating cost in traditional method, Rs ha ⁻¹ ,	5000.00	5000.00	5000.00	5000.00
Net saving over conventional method, Rs ha ⁻¹	3000.00	3078.00	2800.00	2920.00

Conclusions

The tractor drawn Sugarcane transplanter for the sugarcane seedlings grown in protrays had a field capacity of 0.29 ha h⁻¹ at optimized speed of operation of 2.54 km h⁻¹. The study also showed that the net savings over traditional method was Rs.2920 ha⁻¹. The cost analysis of the transplanter revealed a significant savings in costs and time thus could be adopted as an effective mechanization tool for planting

of sugarcane bud chip seedlings. The planter could be used as an effective planting tool in Sustainable Sugarcane Initiative programme for sugarcane.

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