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# **Tractor Operated Cassava Harvester**

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## **Introduction**

Cassava (*Manihot Esculenta* Crantz) is a staple food crop cultivated in several developing countries. Globally, Cassava is grown in an area of 18.51 million ha with a production of 276.65 million tonne (FAO, 2012). India acquires significance in the global cassava scenario due to its highest productivity of 27.92 t/ha. It is cultivated in an area of 0.26 million ha in country with a production of 7.2 million tonne. About 90 per cent of total cassava area and production in India are confined to Salem, Namakkal, Erode, Dharmapuri and Villupuram districts of Tamil Nadu. An average productivity of cassava in Tamil Nadu is the highest in the world.

Cassava is a perennial shrub which sometimes reaches the size of a small tree. The stems vary in color from pale to dirty-white to brown marked by numerous nodes formed by scars left by fallen leaves. Pale to dark-green leaves are of fan shape with 5 to 9 lobes. Cassava is grown at different row to row and plant to plant spacings. The common spacings are 600 x 600 and 750 x 750 mm. These spacing of the crop result in spacing between the alternate rows of 1.2-1.5 m.

Roots of cassava plants are a few and swallow and some become storage roots. These are clustered around the base of the plant and extend about 600 mm on all sides. The crop is cultivated for roots which contain 15-40% starch. A single root may weigh up to 4 kg under favorable conditions. The number of roots per plant varies from 2 to 7 with an average length of 275-435 mm and diameter of 45-75 mm at the time of harvest.

There is a need of an equipment for easy harvest and transport of cassava so that farmers can directly sell the product to the mill and get considerably higher monetary benefit. The different harvesters available in African countries cannot be used under Indian conditions due to large difference in yield of crop and weight of the roots. To eliminate the above problem, a tractor operated cassava harvester was developed by Agricultural Machinery Research Centre at TNAU, Coimbatore.

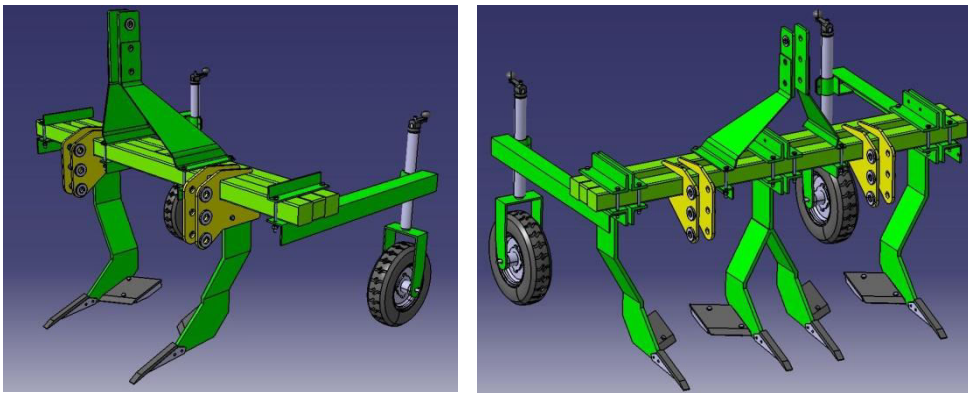
## **Traditional Practice of Harvesting of Cassava**

The different unit operations for cassava harvesting are loosening the roots and pulling up the plants, removing soil and separating the roots, collecting the roots and loading the roots for transport. The traditional practice of cassava harvesting includes loosening the soil using crowbar, if the soil is compact. The plant is pulled up gently without dragging the roots. The dragging can cause bruises and cuts to roots which may lead to early deterioration.

The cassava harvesting is a tedious work and requires around 40 man days/ha. The sale price of cassava is determined by its starch content. The farmers contract the entire harvesting, transport and sale to middleman and this leads to low price for farmers.

### **Salient Features of Cassava Harvester**

The harvester consisted of main frame, shanks, digging blade, hitching frame and depth adjustment wheels. It is designed for both two rows and single row operation (Fig. 1). The blades were mounted on three standards. The centre standard was designed to carry a pair of digger blades assembly. The standards were attached to the main frame by means of clamping plates and the position of each standard could be adjusted separately. During two row digging, the center, right and left bottoms were used while for single row operation, right and left bottoms were used. The spacing between the bottoms could be adjusted as per the requirement of crop and soil conditions. The shank was designed as a bent leg plough with an angle of  $150^\circ$  to accommodate the dug Cassava tubers. The blade angle of  $20^\circ$  was provided for easy penetration into the soil. The row spacing could be altered by moving the shanks on the main frame. The depth wheels were provided to adjust the depth of operation.



**Fig. 1. Tractor operated single and two row Cassava harvesters.**

The implement was fitted with two pneumatic wheels mounted on caster. The wheels were mounted behind the digger blade. This helped the digger blade to get support between the rear wheels of the tractor and the gauge wheels without pitching. The variation in depth of operation was minimum. The spacing between the ground wheels was fixed at 1500 mm. The weight of single row and two row harvesters was 192 and 250 kg, respectively. The specifications of single and two rows Cassava harvesters are given in Table 1 and their salient features are as follows.

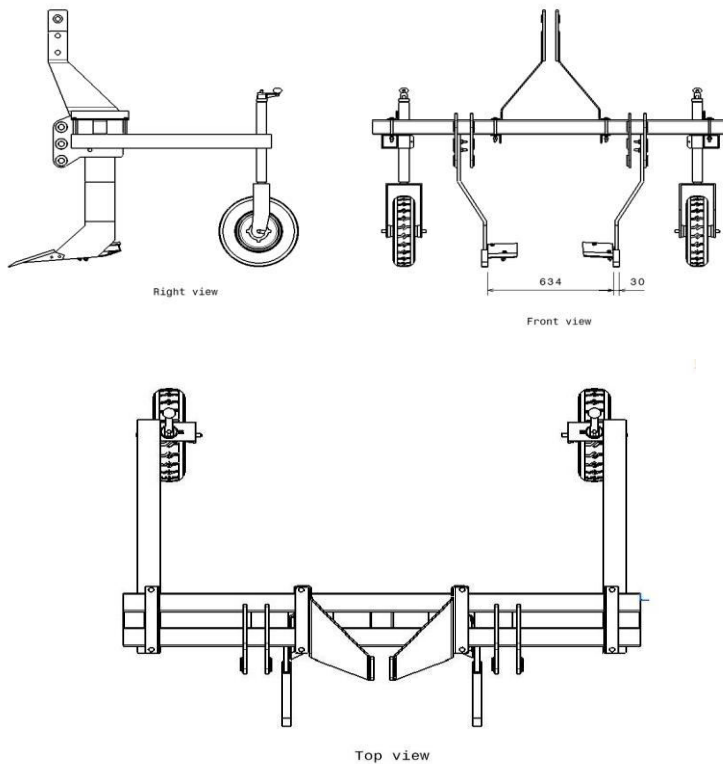
- i. Single offset row or two row operation
- ii. Open center design of digger to lift cassava tubers without damage

- iii. Chisel type share to ensure proper penetration under hard soil condition
- iv. Tubular structure for strength and rigidity
- v. Frame designed to ensure free flow of dug tubers through the blades.
- vi. Ground wheel to ensure uniform depth of operation.

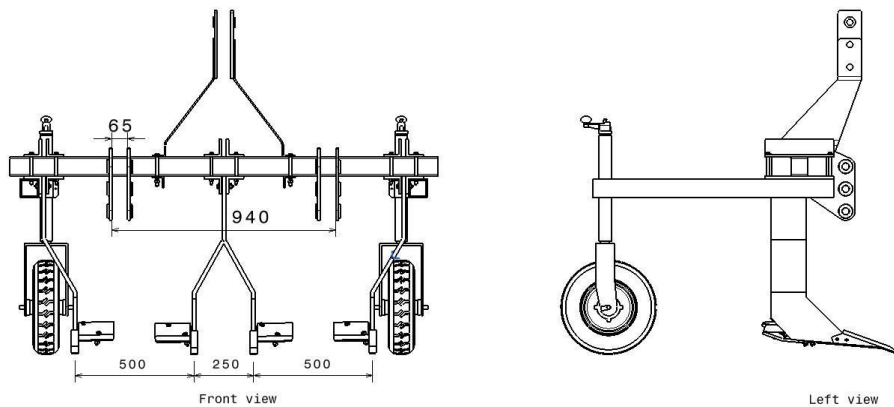
**Table 1 Specifications of single row and two row Cassava harvesters**

Item	Single row Cassava harvester	Two row Cassava harvester
Dimensions (l x w x h), mm	1800 x 1420 x 1460	
Share (L x W x T), mm	250 x 30 x 15	
Blade (L x W x T), mm	200 x 170 x 130	
Bent leg shank (L x W x T), mm	700 x 150 x 16	
Weight, kg	190	250
Power source	37 kW tractor	

The different views of the developed single row and two row units are shown in Figs. 2 and 3, respectively.



**Fig. 2. CAD drawings of single row Cassava harvester.**



**Fig. 3. CAD drawings of two rows Cassava harvester.**

### **Performance of the Machine**

The tractor operated single row and two row Cassava harvesters were evaluated in red sandy loam soils. All the trials were conducted with Mulluvadi (MVD) variety of Cassava cultivated prominently in Tamil Nadu. The field trials (Fig.4) were conducted at farmer's fields near Anthiyur in collaboration with SPAC Tapioca Products Pvt. Ltd., Anthiyur; Krishi Vigyan Kendra, Gobichettipalayam and Agricultural Research Station, Bhavanisagar. The draft required for operation of single row Cassava harvester was 4500 N. The effective field capacity and field efficiency of single row Cassava harvester were 0.07-0.09 ha/h and 80-85%, respectively. The percent damage varied from 0.08 to 0.12% and cost of operation was 6415/ha for single row Cassava harvesting unit. The effective field capacity and cost of harvesting for two rows unit were 0.12 ha/h and Rs 4472/ha, respectively (Table 2).



**Fig. 4. Operation of single row and two row Cassava harvester in field.**

**Table 2. Performance of tractor operated Cassava harvesters**

S. No.	Parameters	Values	
		Single row	Two rows
1.	Area harvested, ha	1.8	0.4
2.	Moisture content, %	16.26	16.50
3.	Speed of operation, km/h	1.2-1.5	1.00
4.	Effective digging width, mm	570	1200
5.	Depth of operation, mm	350-400	350-370
6.	Field capacity, ha/h	0.08	0.12
7.	Digging efficiency, %	97.46	97.40
8.	Undug tubers, %	2.2-2.7	2.5-2.7
9.	Damaged tubers, %	0.09	0.09
10.	Field efficiency, %	80-85	80
11.	Fuel consumption, l/h	4.40	5.10
12.	Labour requirement, man-h/ha		
	a. For detopping	12	12
	b. For collection (women)	12	12
	c. Total	24	24
13.	Cost of operation, Rs./h (Rs./ha)	483 (6415)	483 (4472)
14.	Cost of harvesting in conventional method, Rs/ha (contract)	10,000	10,000
15.	Saving in cost over conventional method, %	36	55
16.	Labour saving over conventional method, %	88.84	90
17.	Benefits per unit per annum, Rs.	111100	165840

**Status of the Technology**

The tractor operated Cassava harvester was extensively tested for its feasibility at farmer's fields in collaboration with KVKs of TNAU, Coimbatore and Sago industry. Two units of single row Cassava harvesters were sold to KVK, Yethapur and KVK, Sandhiyur in Tamil Nadu. Three units of harvesters were also supplied to KVKs and one unit was under fabrication for supply to CTCRI, Thiruvananthapuram. Farmer's fares were organized for creating awareness about the implement in the Cassava growing areas of Tamil Nadu with the help of KVKs. The tractor drawn Cassava harvester was released by the State Variety Release Committee, Tamil Nadu in 2014.

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