

Performance evaluation of manually operated drumstick harvester

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■ **ABSTRACT** : Harvesting of drumstick pods by traditional methods such as use of hook and bamboo, climbing labour on tree is difficult task. In order to reduce losses during harvesting of drumstick and to maintain fruit quality, a manually operated drumstick harvester was developed at K. K. Wagh College of Agricultural Engineering and Technology, Nashik. The testing of harvester was taken at Mr. Narayan Shelar drumstick farm and Puriya park farm. This harvesting machine includes four components namely shearing device, operating mechanism, supporting structure and collector bag. The working of this manually operated drumstick harvester is based on the principles of simple brake mechanism. During operation, it was observed that force required to cut the drumstick stalk was 5-15N and shearing strength was 0.33-0.75 MPa. The actual field capacity of harvester was 0.01323 ha/hr. Drumstick harvester become multipurpose to harvest sapota, mango, custard apple etc. by using of movable scissor which rotated in 180° for that holder is used.

■ **KEY WORDS** : Drumstick pod, Hook and bamboo, Drumstick harvester, Shearing strength, Multipurpose, Actual field capacity

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India is the largest producer of drumstick tree (*Moringa oleifera*) in the world, with an annual production of 1.1 to 1.3 million tons of tender fruits. Andhra Pradesh leads in both area of plantation and production of drumstick, followed by Karnataka and Tamil Nadu. In Maharashtra, drumstick is cultivated over around an area 800 ha. In India local name is shevga (Marathi); sanjna, suhujna (Hindi); murunga, murangai (Tamil) are mention for drumstick tree.

Moringa oleifera is a small, graceful, deciduous tree with sparse foliage, often resembling a leguminous species at a distance, especially when in flower, but immediately recognized when in fruit. The tree grows to 10 m high. Flowers produced throughout the year. Fruits are large and distinctive upto 90 cm long and 12 mm broad. The moringa tree prefers well-drained sandy or loam soil. It will tolerate a clay soil but not water

.When the plant is grown up for cutting, the best first harvest can already take place after 6-8 month after plantation.

In the next year, it produces around 300 pods and in successive year around 400-500. A good tree can yield 1000 or more pods. In India a hectare can produces 31 tons of pods per year. Under North India conditions, the fruit ripen during the summer. Sometimes particularly in South India, flowers and fruits appear twice a year and so there are two harvests, in July to September and March to April.

Almost all parts of the drumstick tree are used for food, oil, fibre, and/or medicine. In the Pacific, the most important products are pods and leaves. Young pods are consumed as a vegetable. Very young pods are fibre less, and can be cooked like string beans. The demand for home consumption of pods and leaves can generally

be met by one or two backyard trees. Leaves are readily eaten by cattle, sheep, goats, pigs, chick and rabbits and can also be used as food.

The development of Indian agricultural sector depends on the development of farm mechanization, so that there should be introducing such a machinery and equipment to fulfill the need of the labour which is major problem now a days, and also reduces the human drudgery and the product damages. Under such requirements there is no equipment available for harvesting drumstick which is a popular vegetable in south Indian states. Currently drumstick harvesting is done manually with knife sickles and stabs with hook attached to it. Skilled labour is to be needed for such traditionally harvesting method of drumstick. Drumstick tree is very delicate to climbing hence, there should be accidental chances for labour.

Losses due to traditional method to farmer :

- The damaged pods get fewer market prices.
- Breakdown of the branches of drumstick.
- Due to falling of blossom, the future bearing is reduced to a great extent.
- The tender pods can't be sold in the market as they are of no use for consumption.
- Difficult to handle and operate hence, it will give physical hazard to operator.
- Efficiency is very less

To overcome such a problem, there is a need for design and development of manually operated drumstick harvester, which makes easy cutting of the stalk and easily conveys the drumstick pod.

Mehra *et al.* (2012) studied the design and development of a pepper plucking equipment to facilitate pepper harvesting in the agricultural sector, in order to avoided climbing. Karim (1988) suggested that chiku harvester could be modified to harvest other fruits requiring horizontal cutting motion due to their orientation on the tree that. Hamedon *et al.* (2008) studied the harvesting pole, specifically designed for palm trees, was designed, developed and tested.

Objectives :

To study the performance of manually operated drumstick harvester.

To study operation performance of manually operated drumstick harvester with traditional method.

■ METHODOLOGY

Manually operated drumstick harvester was developed according to tree, implement and operator parameter. All the testing of equipment was conducted on Mr. Narayan Shelar drumstick farm at Ozer Mig (Nashik) and Puria Park farm (Nashik).

The length and diameter of the pods and diameter of stalk were measured with the help of measuring scale and vernier caliper (Table A and Plate A, Table B and Plate B).

Sr. No.	Pods	Length (mm)	Diameter (mm)
1.	A	500	8
2.	B	650	8.5
3.	C	450	9.5
4.	D	500	8
5.	E	600	10
	Mean	540	8.8



Plate A : Measurement of pods dimension of drumstick tree

Sr. No.	Name of tree peduncle	Diameter of stalk (mm)	Mean (mm)
1.	Drumstick	4.4	4.3
		4.3	
		4.2	
2.	Sapota	4.5	4.5
		4.6	
		4.5	
3.	Custed apple	5.0	5.1
		5.2	
		5.1	

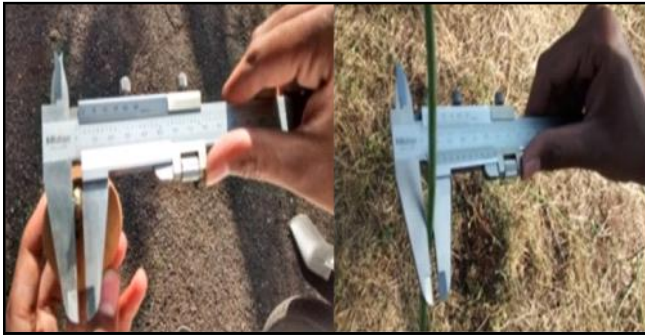


Plate B : Measurement of stalk dimension of drumstick tree

Testing of manually operated drumstick harvester:

The measurement of different parameters involved in testing manually operated drumstick harvester was carried out according to RNAM test code IS 6316: 1993.

Test condition :

The details of field test are explained under following section.

Test plot :

Mr. Narayan Shelar drumstick farm of area 20R at Ozar Mig (Nasik) was selected for conducting trial of manually operated drumstick harvester. Details of test plot are presented in Table C. The table included plot, location, shape, area of the field, kind of field and type of soil.

Sr. No.	Particulates	Test
1.	Date	28/11/2014
2.	Location	Ozar Mig (Nashik)
3.	Shape	Rectangular
4.	Area of the field (m ²)	4000m ²
5.	Type of soil	Sandy loam
6.	Kind of field	Upland

Crop condition :

The crop conditions were considered during testing are physical properties of drumstick plant, maturity indices, harvesting index etc. The details of crop condition are given in Table D. The table included the details about name of crop, planting pattern, row spacing, and stage of growth day after sowing and height of crop.

Condition of implement and operator :

The condition of implement and operator was

Sr. No.	Particulates	Test
1.	Variety of plant	Rohit
2.	Height of plant	4-4.5 m
3.	Distance between two plant	2.5 m
4.	Length of pod	400 mm
5.	Diameter of pod	10 mm

important for field efficiency and net operation. Field efficiency was directly depending upon skill of operator. If skill of operator was very good then field efficiency was best. The details of condition of implement and operator are in Table E. The table included the details about source of power, skill of operator, weight of implement, maximum height of implement, adjustment of working part, clearance between scissor and lever (Fig. A).

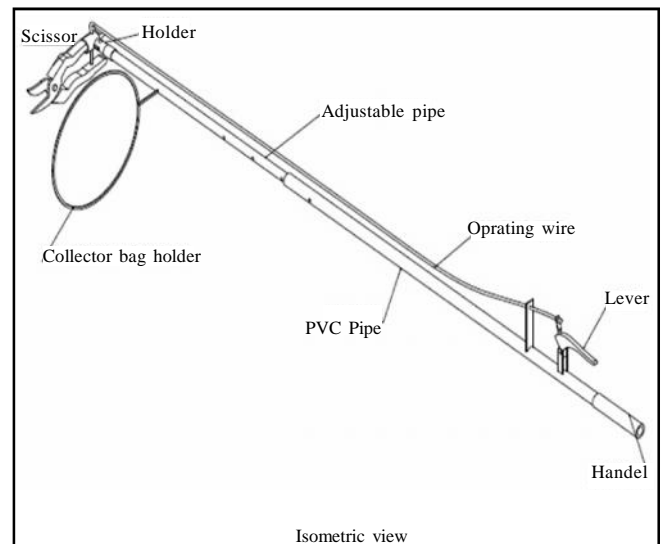


Fig. A : Isometric view of manually operated drumstick harvester

Sr. No.	Particulars	Performance test
1.	Source of power	Human mussel
2.	Weight of implement	1.3 kg
3.	Max height of implement	6.5 feet
4.	Adjustment of working part	
	- Scissor	Rotate in 180°
5.	Clearance	
	- Scissor	45 mm
	- Lever	100 mm
6.	Skill of operator	Not necessary

Table 1 : Actual field capacity of manually operated drumstick harvester

Sr. No.	Area (ha)	No. of tree	No. of pods	Productive time (min)	Non-productive time (min)	Actual field capacity (ha/hr)
1.	0.05092	100	4000	148	40	0.016
2.	0.05092	100	4400	176	60	0.01295
3.	0.05092	100	6000	214	70	0.01076
4.	0.05092	100	5000	166	65	0.01322
Mean	0.05092	100	4850	176	59	0.01323

Table 2 : Comparative result between traditional tool and manually operated drumstick harvester

Particulars	Traditional method (Hook and Bamboo)	Drumstick harvester
Area	2000 m ²	2000 m ²
No. of pods cut in 1 hrs	700	1500
Ease of operation	Difficult	Easy
Total time required for operation	1400 min	940 min
Damage to pod	Yes	No
Labour required	1	1
Cost of operation	Rs. 900	Rs. 600

■ RESULTS AND DISCUSSION

Drumstick harvester was developed by considering ergonomics study, tree, and implement and operator factor. This harvesting machine included four components namely: shearing device, operating mechanism, supporting structure and collector bag. After the field test, the performance results are tabulated in Table 1.

Manually operated drumstick harvester was compared with traditional tool, from this testing the results are obtained tabulated in Table 2.

Conclusion :

- The developed the harvester was suitable for harvesting the pods at the exact stage and maturity and actual field capacity was 0.01323 ha/hr.
- Cost of harvesting of drumstick harvester was less than traditional method.
- Its price came to nearly Rs. 550/- which is affordable to Farmer.
- It is light weight and therefore, can easily be carried from one place to another.
- The scissor was movable so it is used to harvest sapota, mango, custard apple etc. hence, it became multipurpose.
- The harvester was most efficient and comfortable according to ergonomic observations.

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