

## **DESIGN AND PERFORMANCE OF A PROTOTYPE MOTORISED MANGO HARVESTER**

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### **ABSTRACT**

A prototype motorised hand-held mango harvester was designed and fabricated at the Faculty of Engineering, University of Agriculture Malaysia. The harvester is aimed at reducing the harvesting operation time, improving the working comfort during the operation and increasing the harvesting capacity. The mango harvester consists of gripping and detaching devices, a power transmission shaft with a 12V battery operated motor and an aluminium pole together with a collecting chute. Preliminary observation on the harvester's performance showed significant and satisfactory results. It was found out that the mango harvester was capable of harvesting on an average six seconds for each fruit detachment. Further study is being conducted to improve the efficiency and capacity of the mango harvester.

Key Word : Design, Performance, Motorised Mango Harvester

### **INTRODUCTION**

The Malaysian local fruit industry offers lucrative returns and promises a very bright future for the industry's development. Since the launching of the National Agricultural Policy in 1984, the fruit industry in Malaysia develops tremendously and it has been expected that the industry will contribute to about RM 2.97 billion (US \$1.20 billion) in 1995 as compared to RM 1.70 billion (US \$0.68 billion) in 1989 for the country's Gross National Product (FAMA, 1990).

Traditionally, the harvesting of fruits is done manually. Mango fruits are grown in small hectares. Various techniques of mango harvesting are being practised in the mango farms. The use of manual cutters, rakes and pluckers are widely accepted in carrying out the harvesting operations. Mango fruits which are low and near to the

ground are easily plucked or harvested. Sometimes a person needs to climb the mango tree and carry with him a bag and cutter blade for harvesting. Also, long bamboos are used to harvest tall mango trees and often trees are shaken in order that the ripened mango fruits will drop on the ground (Samson, 1986). Various manual harvesting devices used in mango harvesting are shown in Fig. 1.

A motorized mango harvester was designed, constructed and tested at the Faculty of Engineering, University of Agriculture Malaysia. The above device was aimed at improving the harvesting technique, capacity and efficiency (Muhamad Ruhni, 1992).

## **MATERIALS AND METHODS**

The mango fruit harvester was designed according to the physical and mechanical properties of the fruit and the nature of the tree. The shapes and sizes of the mango fruit (Clone: Harum Manis MA 128) vary from 75 - 120 mm in diameter and between 140 - 220 mm long (Muhamad Ruhni, 1992). The tree height also varies from 5 - 6 m with its canopy diameter ranges from 5 - 6 m (Fig. 2).

The prototype mango harvester uses a gripping and detaching principle. It consists of a small 12 V battery operated motor to pull the catching frame and simultaneously grip the mango stalk. The detaching device consists of six - 34 mm iron rods which were placed at 50° inclined towards the chute. The gripping device consists of corrugated zinc plates. The mango fruit will be detached from the stalk and dropped through the chute into a container (Fig. 3 and Fig. 4).

The mango harvester was easily hand-held and a strapper was used to carry the harvester. A 220 cm x 34 mm diameter aluminium pole was used. Sample of mango fruits were harvested and the preliminary observation on the machine performance was recorded in terms of total time taken to grip and detach the fruits.

## **RESULTS AND DISCUSSIONS**

Mango fruits were harvested and the average fruit characteristics and the gripping and detaching time are shown as in Table 1. The average gripping and detaching time was about 6 seconds for a single fruitlet. Eventhough the harvester was capable of harvesting the fruit successfully, the operation was quite slow.

From the preliminary observations, there was no fruit injury incurred during the harvesting operation. The present motor has to be improved further in order to quicken the harvesting time probably from 6 seconds to 3 seconds per fruit detachment.

Few problems were encountered during the harvesting operation and these include:

1. Difficulty of placing the gripping and detaching device,
2. Low gripping capability,
3. Distant fruitlet, and
4. Present of branches around the fruitlet.

All these factors affect the capacity and efficiency of the harvesting of mango fruits.

## **CONCLUSIONS**

The mango harvester functions well and provides new dimension on harvesting technique for fruits. Further study has to be carried out to improve the mango harvester. A pneumatic system will be replacing the present battery operated motor system in order to sustain long hour operation and multiple usage of harvester per tree besides a faster harvesting operation.

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**Table 1. Average characteristics for mango fruit and gripping and detaching time**

Fruit Weight, g	367
Fruit Diameter, mm	81
Fruit Length, mm	128
Stalk diameter, mm	5
Detached stalk length, mm	9
Gripping and detaching time, sec	6

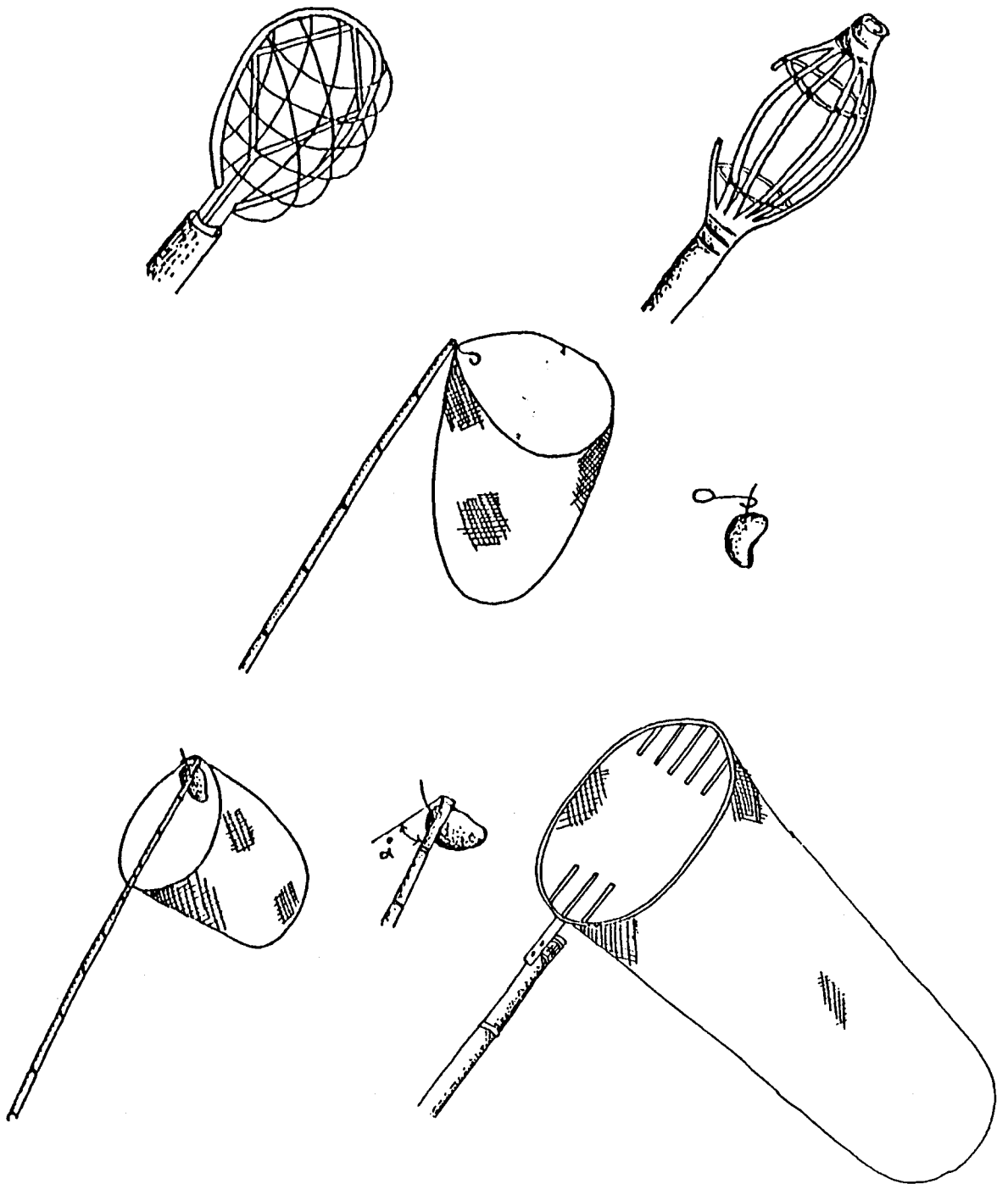
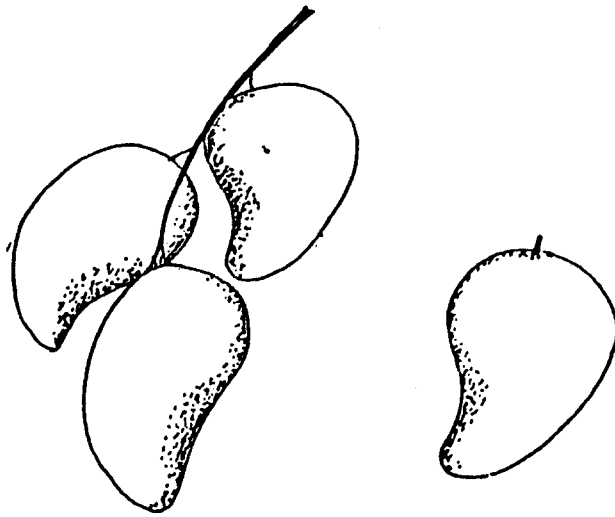
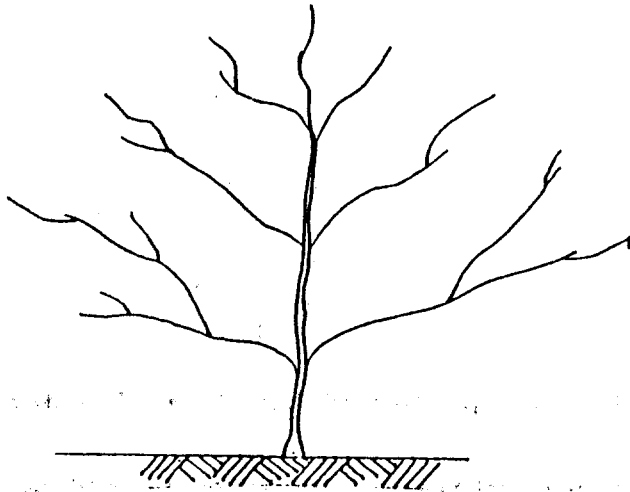


Fig. 1 Various traditional mango harvesters

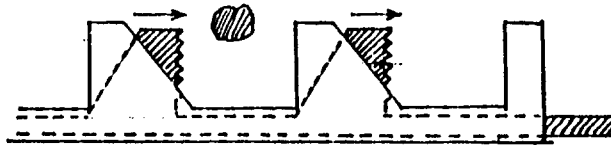


**a) Mango fruits**

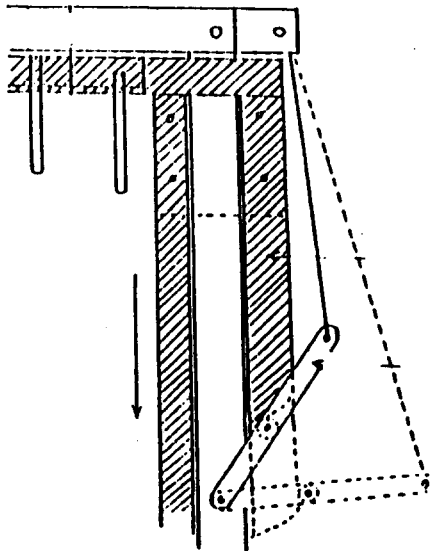


**b) A view of the mango tree**

**Fig. 2 Mango fruit and tree characteristics**

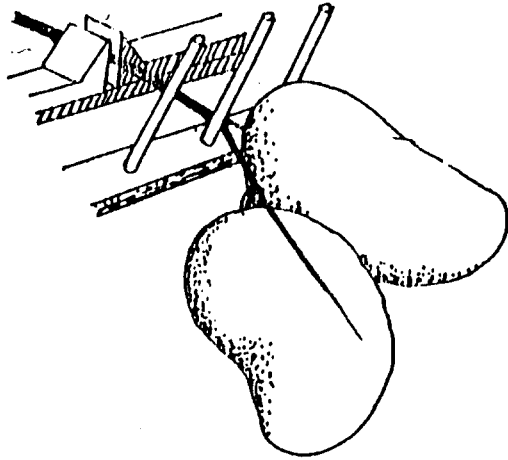


a) A cross-sectional view of the gripping device

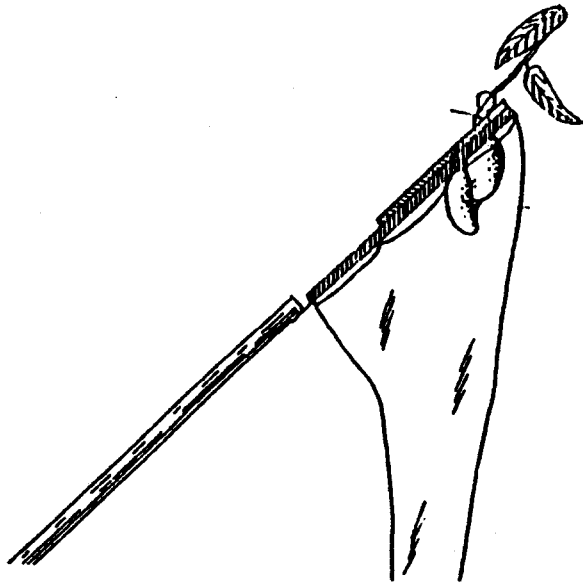


b) A top view of the detaching device

Fig. 3 Sectional views of the gripping and detaching devices



a) Mango gripping device



b) Mango fruit detaching device

Fig. 4 Mango fruit gripping and detaching devices