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Evaluation of Mango Harvesting Methods at Nakhon Pathom

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ABSTRACT

Five means of mango harvesting, a) ratten takraw, b) locally-made 4 wheel harvesting vehicle, c) 3-wheel harvesting vehicle, d) locally-made 4 wheel harvesting vehicle together with 2-m. long ratten takraw, e) 3-wheel harvesting vehicle together with 2-m. long ratten takraw, were employed to harvest mangoes of Keo-Savoey variety. For three different height ranges of the mango tree 2 to 4 meters, 4 to 6 meters, and beyond 6 meters, the harvesting vehicle with ratten takraw exhibited the highest harvesting rate of 141 kgs./hr. while the use of ratten takraw could work averagely 76 kgs./hr.

Keywords : mango, harvesting method

INTRODUCTION

Presently, Thailand is an exporter of fresh fruits, of which both quantities and varieties are increasing steadily. In the year 1975, a total of 107, 677 metric tons of frozen fresh vegetable and fruit was exported to foreign market and was valued about 1,177 million baht. From this figure, the exported fresh fruits was counted to 76,879 metric tons of 992 million bahts value. In the year of 1976, Thailand was able to increase the volume of fresh fruit export up to 90,657 metric ton and was valued 1,124 million baht. The increase of total export value from the year of 1975 to 17.6 percent (Praspas, 1977) promotes the expansion of fruit production for export.

1.1 The Importance of fruit harvesting.

The quality of the harvested crop is very important for fresh fruit production as the quality of fresh fruit will secure both the price and sale volume the quality of fresh fruit depends on not only from intensive care, handling operation before harvesting and the proper mature stage of harvesting but also the method of harvesting and handling operation employed in the process. The proper harvesting indices are very important to attributes of flavors, color and other quality of fruit, but, the harvesting methods and tools are also very important to the fruit quality. Improper harvesting methods, inappropriate and inefficiency harvesting tools will damage both quality and quantity of fruit. For expample, the mechanical injury to the skin of fresh fruit will decrease consumers acceptance, shorten storage life of fresh fruit, losen the weight because of increasing respiration rate and easy attack by desease-causing microorganisms (Saichol, 1985). Poor practical harvesting, the risk of climbing tall trees while picking, delayed harvesting and labor-intensive employment affect the loss of income of farmers and producers, hence the appropriate harvesting machinery and tools will decrease these problems.

Fruit harvesting for fresh fruit market is mostly accomplished by hand picking, harvesting tools or man-positioning platforms (Ryall and Pentzer, 1982). From orange harvesting study, Schertz (1967) found that the picking of fruit on the ground will pick more fruit than the picking on the laddle about 29 percent. Orange picker standing on the ground will have more efficiency than the picker on the tree about 25%. From

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this data, it indicates the picker standing on the ground will pick more efficiently than the other. hence there was an idea of providing aids to enable picker for reaching high fruits from the ground by using manpositioning platforms where the picker is able to stand and pick likely on the ground. Furthermore, the consumed energy per time unit for carrying and placing the laddle to the tree was twice for the harvesting. Also, the carrying of collected basket full of fruit, consumed the energy per time unit more than the harvesting method by laddle 35 percent.

1.2 Harvesting of mango

Sivaluk (1989) reviewed various fruits harvesting methods in Thailand with the emphasis on availability of picking methods and tools.

The harvesting indices for mature-green mango are that a fruit is harvested when it attains full size, the endocarp becomes lignified and hard and the cheeks are fully developed. Furthermore, the skin colour will change from dark green to pale or the trace of yellow near the stem end. The flesh color will turn from white to light yellow and heavy bloom will deposit on mature fruit. Also the specific gravity of mature fruit is greater than one so it sinks in the water. The over mature mango should be avoided to pick as this may cause poor quality of flavors, odor and color. Harvesting should be handled with care as mango is the thin skin fruit which easily damage by injury. Especially, mango has much latex which exudes from the cut stem surface after picking and causes staining if allowed to drip on to the peel. Latex stains reduce the quality of fruit and are particularly objectionable to consumers in the export market. Mango with more than 2 inch of peduncle attached could be more easily handled in such a way as to prevent latex draining of the fruit.

Presently, there are various kind of harvesting methods such as for young trees where hand picking is convenient, farmers will use scissor to cut fruit with a length of peduncle attached and collect in basket. To obtain fruit that is beyond reach, they would use ladder or climbing up the tree and then harvest with ratten takraw, or using trimming scissor are used to cut the fruit around the radius stem, When the ratten takraw is fulled, the mangoes will be transferred to container hanging on the tree near the picker. When the collected container is full the hanging rope will be extended to allow the containcers reaching the ground for further tansfer to the new container. In the case that mango has a length of peduncle attached, the pedunce is removed near the stem end and then place the fruit with the stem-end down on the ground to prevent excessive latex staining on the peel of mangoes. Then simultaneous orchard operations of post harvesting will continue.

The picking by ratten takraw causes draining of latex staining on the peel of mangoes while picking by trimming scissors gives mango with attached peduncle but this operation allows one fruit or one group per batch which is a very slow process

1.3 Mechanization in the harvesting of fruit

Mechanization in the harvesting of fruit can be divided into 2 types.

1) Harvesting device or picking tool
2) Man-positioner or power ladder

The picking tool used in the Philippines is similar to the fishing net made of rattan or bamboo stick formed into a circle basket which is attached to a bamboo pole or other lightweight material and at the back of the circle equiped with bended knife. (Kosiyachainda, 1984). Picking tool type QC 21 was made of ironloop equiped with knife for cutting the peduncle of fruit when the rope was pooled. There was the cloth pouch under the loop to receive the dropping fruit. This device was attached to a 1-4 metre long bamboo pole. This device can use with many kind of fruit such as mango, orange and avogado (Surapong, 1987). Sivaluk et. al. (1990) designed and developed various kinds of picking device for specific fruit such as lambutan, mangosteen, sweet tamarin, papaya pomelo. These picking devices are in good operating, no damage to the fruit and no dropping from the pouch. Testing with mango, the picking device called Kor Vor Sor 1 was able to pick mango 5-7 fruits per batch or 452 fruits per hour with long peduncle and no latex staining on the peel.

Man positioner or power ladder

Parata and Chairat (1989) designed and tested two types of harvesting machine for mango. Type I consisted of 3 -wheel vehicle drived with small power engine, controlled direction at front wheel and needed two operators. The results from testing the harvesting machine with mango garden with densed grow and no corrugated irrigation canal, found that harvesting machine Type 1. of 175.0 cm wide and 373.5 cm long with unadjustable vehicle operating floor could pick the mango at the level of 2.7 metre height form the

ground. The operator or picker should be 1.65 m tall. The rate of picking was 6.29 second per fruit when compared with rattan takraw of 15.52 sec/fruit. The problems of Type I harvesting machine were that the difficulty of power engine to drive on rought and big soil, wide angle of turn round, uneasy operation and limiting of high mango tree which far from hand picking. harvesting machine of type 2 consisted of 151 centimetre wide, 306 centimetre long, adjustable vehicle operation floor with hydraulic system of 79 to 140 centimetre high from the ground. The testing results found that it could harvest 3.5 metre high from the ground with average time of 6.26 seconds per fruit while together with the ratten takraw of 4.25 metre long, it could pick at the level of 7-8 metre high from the ground with the rate of picking 15.07 second per fruit. Harvesting mango without peduncle was 6% with hand picking and 60% with ratten takraw.

In Japan, the fruit is harvested by 3-wheel movable step ladder where the picker picks the fruit by scissor cutting or by hand and collects in the basket until the basket is full then it is changed.

The man-positioner in Japan is moved by 6-8 horse power engine where the manpositioning platforms can move through a vertical axis, turn leff and right by hydraulic system controlled by picker on the platform. This harvesting mahcine is popular with fig, orange and pear.

For harvesting vehicle in United State of America, Molitorisz and Perry (1966) reported that for orange harvesting, the man-positioner consisted of frame hydraulically moved through a vertical arc and the horizontal platform which is movable controllable. The frame of this vehicle is 15 feet high, with 3 feet turning radius and driven by electric motor which also used to move the platform up and down. transmission by electric clutch for control the moving on the ground.

O' Brien et. al. (1983) reported that the singleman positioner which was able to control the movement of the car, was more convenient and productive harvesting of fruit. The platform was able to move in three dimensions but this singleman positioner is costly and available for only one worker. The multi boom vertical worker positioner was available for several workers and the platforms were movable in the vertical axis. Whitney et. al. (1969) reported that the harvesting vehicle of multi-worker positioner was available for up to 10 workers and some types the platforms were also movable in the horizontal axis to reach the inner radius of the fruit tree. The vechicle was forward moving and equipped with many level of platforms where there were enough space for workers to walk and pick the orange fruit. This type of vehicle was selfpropeller and suitable for harvesting fruit-trees which were grown in good row of 1.8 width between the rows for the convenience of car moving. The trees should not be taller than 3 m. because the first level of platform is about 0.6-1.8-3.0 m. and the tree should grow in consistent height such as apple peach pear and figs. Since the fruit harvester with man positioner for workers picking can provide fruit of high quality and free from severe bruises then the fruits are acceptable for fresh fruit market.

Jakara et. al. (1986). reported that fruit harvester with man positioner No. 329 manufactured by Wang Noi Company Limited, was the four wheel machine driven by rear gear system and equiped with man positioning platform which was hydraulically moved through a vertical axis and could control the movements of upward, downward, forward, backward, turn left and right all on the platform. The machine vehicle was 132 cm. wide 204 cm. long, of 700 kg weight and 7 horsepower engine. The platform was able to weigh 200 kg at the height of 6 m. Comparing efficiency of rambutan harvesting between using man positioning platform and pooling by the circle knife with the long pole used by farmers, was the same rate of harvesting. However, the sophisticated man-positioner had more advantages in use less labor and high quality rambutan of no bruises which was suitable for export market. The tree was less damage from climbing and the picker was safe from falling from the tree. The disadvantages were that the worker must turn backward to the tree then the worker could not see the clear target. The problem of controlling the direction of platform was time consuming.

This rescarch would like to compare various fruit harvesting methods both by manual labor and machine with no study before in Thailand with mango fruit.

MATERIALS AND METHODS

Materials

1. Three-wheel harvesting vehicle developed by the project.
2. Locally-made 4 wheel harvesting vehicle
3. Ratten takraw for mango harvesting of 2 and 4 metre long.

4. The weight of one and sixty kilogram.
5. Watch
6. Mango trees of consistent size and maturity of fruit.

Methods

Five means of mango harvesting a). ratten takraw of 4 metre long. b). locally-made 4 wheel harvesting vehicle, c). three-wheel harvesting vehicle developed by Agricultural Engineering Department and National Agricultural Centre d). locally-made 4 wheel harvesting vehicle together with 2-m long ratten takraw and e). three-wheel harvesting vehicle together with 2-metre long ratten takraw, harvested at different levels of 2-4 metre, 4-6 metre and beyond 6 metre high, were tested to harvest mangoes of Keo-Sa-Veoy variety of 0-8 high of trees.

Every mean was tested with 4 repeats except at the level of 2-4 metre high, tested only 3 repeats because of not enough of mango trees.

Collected data for analysing were harvesting time of each mean, harvesting mango weight and dropping harvesting mango weight from pouch.

The test was done in a randomized complete block design of 5 means, 4 repeats and the fruitful of mango as the block of 6 fruits/m2, 8 fruit/m2 and 10 fruits/m2. Harvesting the mango at the levels of 2-4 metre, 4-6 metre and more than 6 metre high.

RESULTS AND DISCUSSION

Mangoes of Kheo-Sawoey variety were harvested by ratten takraw of 4 metre long (Fig. 1), locally-made 4 wheel harvesting vehicle (Fig. 2), three-wheel harvesting vehicle (Fig. 3), locally-made 4 wheel harvesting vehicle together with 2-metre long ratten takraw and three-wheel harvesting vehicle together with 2-metre long ratten takraw. For three different hight range of the mango tree, 2-4 metre, 4-6 metre and beyond 6 metre (Table 1), the average harvesting rates were 132.70, 117.90 and 82.49 kilogram per hour respectively while the statistical difference was significant at 95 percent confidence. Form the figures, while the fruit tree height increased, the harvesting rates decreased with increasing the harvesting time. As harvesting at the level beyond 4 metre heigh by the use of ratten takraw and the workers had to climb up the mango tree. It is time cansuming caring not to fall from the tree and the conveying of fruit containers by the rope to the ground when they fulled for changing the empty ones to the

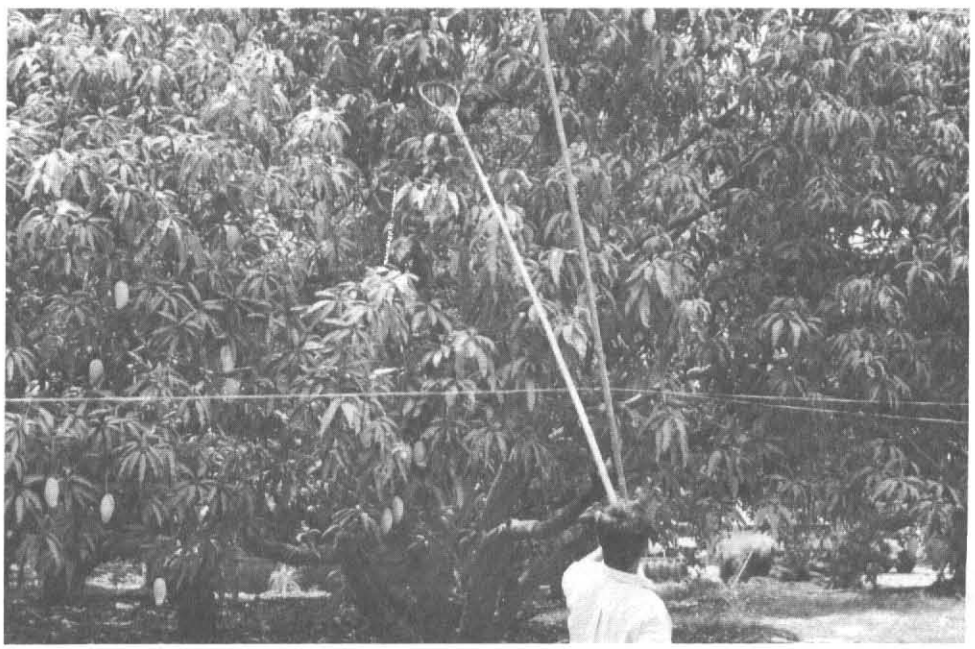

Figure 1 Ratten takraw for picking mango fruits.

Table 1 Comparison of harvesting rate (kg/hr) of 5 harvesting methods worked on mango trees with 3 hight levels.

height	2-4 m.	4-6 m.	> 6 m.	average
harvesting method				
rattan picker 4 m. long	100.64	65.17	62.31	76.04
4-wheel power ladder	144.55	155.24	-	129.90
3-wheel power ladder	149.08	133.29	-	141.18
4-w + RP 1-/	107.64	119.91	80.73	102.76
3-w + RP 2-/	161.58	155.88	104.44	140.63
average	132.70	177.90	82.44	
C.V. = 11.31529 %				

1-/ 4-wheel power ladder with rattan picker 2 m. long
2-/ 3-wheel power ladder with rattan picker 2 m. long

upper tree again. Also the harvesting by vehicle which has to move to change the position and adjust the level of crane height several time more than the harvesting at low level, all these are time consuming for harvesting at high level of the tree. When comparing the harvesting rate of 4 methods of mango harvesting at the range of 3 level height has found that the harvesting rate of ratten takraw of 4 metre long was the minimum of average 76.04 kilogram per hour with significant-statistical difference at 95 percent confi-

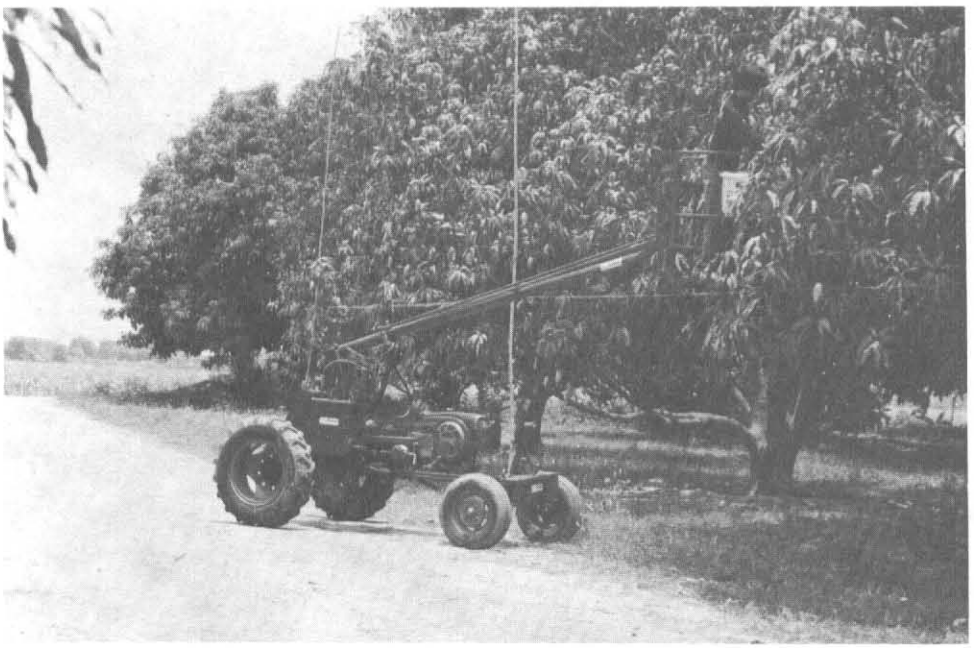

Figure 2 Localy-made four wheel harvesting vehicle for picking mango fruit.

Figure 3 Three-wheel harvesting vehicle for picking mango fruit.

dence. From comparing and analysing by DMRT found that the harvesting means by three-wheel harvesting vehicle with ratten takraw, three-wheel harvesting vehicle and locally-made four wheel harvesting vehicle, had no significant statistical differecne of average harvesting rate of 141, 141 and 129 kg/hr respectively. The average harvesting rate of locally-made four wheel harvesting vehicle together with two-metre long ratten takraw was 102.76 kg/hr. It was found that the factors of harvesting means and the level of height affected the relation of harvesting rate. The harvesting rate by vehicle was twice the time required for ratten takraw.

From observing while harvesting, if there is the harvesting aids which no need to pull the peduncle and the full containers, then more fruits were picked per batch so that the time of taking the mango fruit to fill the container was much decreased. From statistical analysis, there was no statistic difference between different means of mango harvesting for the dropping fruit. Also, there was no mechanical damage to the quality of fruit from different means of harvesting except the drop of fruit to the ground. The mangoes harvesting by vehicle had long peduncle, no latex staining on the peel of mangoes, beautiful bloom, beside these the mangoes attached with long peduncle will extend the shelf life of fruit while distribued to the market. The three-wheel harvesting vehicle together with ratten takraw enhanced the quicker picking because the shorth length of ratten takraw could increase the radius of working area.

CONCLUSION

From testing the five means of harvesting the mango Kheo-Sawoey variety) at three different height range of the mango trees it was found that the harvesting means and the levels of fruit hight, affected the harvesting rate. The harvesting rate decreased with the increase in the height of the tree and the harvesting rate was minimum by the use of ratten takraw alone. The use of three-wheel harvesting vehicle together with two-metre long ratten trakraw gave the highest harvesting rate (141 kg/hr) and it was able to reach the tree of eight high. There was no statistical difference between the means of harvesting for the dropping of fruits to the ground.

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