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Geeta S BhumareCollege of Agricultural
Engineering and Technology,
VNMKV, Parbhani,
Maharashtra, India**Dr. PA Munde**College of Agricultural
Engineering and Technology,
VNMKV, Parbhani,
Maharashtra, India

Performance evaluation of telescopic fruit harvester

Geeta S Bhumare and PA Munde

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Abstract

India is a major producer of coconuts, contribute 72% of the world's total production. In India, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh produces 89% of coconut production and 90% of coconut area. Coconuts are versatile crops used for a variety of purposes but in India, almost 70% of the coconut is used for edible purposes. Coconut trees are productive throughout the year. However, the yield may vary from season to season. A normal-bearing coconut palm usually produces one harvestable bunch on monthly basis. The number of bunches harvested per palm annually reaches about 14 from tall and 16 from dwarf trees. A bunch of coconuts from each tree has 5 to 15 nuts. Coconuts are harvested every month from a coconut palm. On average, 10-45 nuts are collected from each coconut tree at various maturity stages. A telescopic fruit Harvester for small crops was developed and its Performance evaluation of available coconut harvester was under taken. It has telescopic shaft up to 73 feet with sickle shape lade for Harvesting. The number of tree picking and harvested in one hour was observed in range of 6.5 to 11. The time required for extending the height of pole was observed as 8.74 to 10.90 seconds. The time required for fixing/removing the pruning blade was observed as 8.74 to 10.90 seconds. The time required for interchanging the tree was observed as 12.33 to 18.75 seconds. The improved harvesting system found better than traditional methods and reduces musculoskeletal stress on the operator.

Keywords: Coconut harvesting, telescopic fruit harvester, coconut palm

Introduction

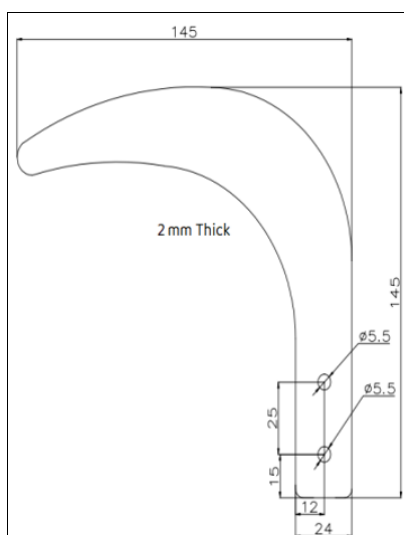
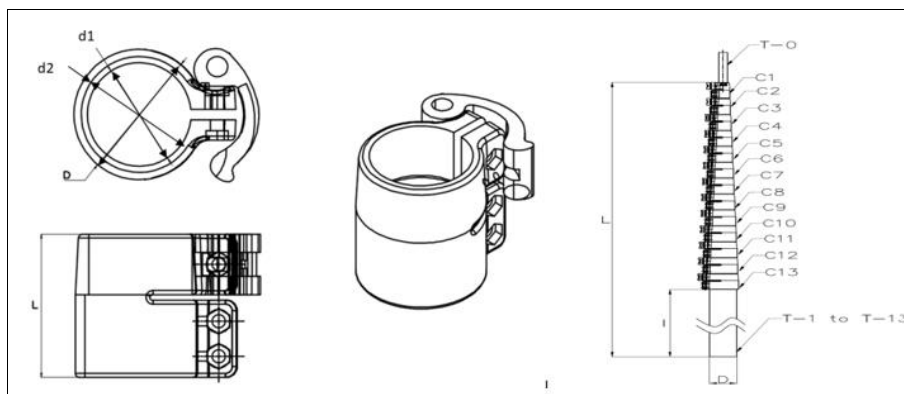
India is a major producer of fruits, vegetables, cereals, pulses, tuber crops and spices in the world. India produces around 40 million tons of fruits per year. World production of tree fruits is increasing rapidly leading to more competition on export market. Adoption of more efficient fruit production and harvesting system is one way for the industry to remain competitive and increase market share on the world stage. Production of fruit crop is expensive and labour intensive. Harvesting is the most labour intensive operation in the fruit production accounting for up to 60% of total labour requirement. Timely harvesting of fruits is important for maintaining quality and shelf life. Harvesting of fruits is a cumbersome and time-consuming process. Different methods are being practiced for harvesting fruits from trees.

Harvesting of coconut, Areca nut is labour intensive operation and may involve 35-45% of total production cost. Most of the Indian farmers still practicing conventional hand-picking methods for harvesting. However, conventional methods are inefficient and more importantly results in risk on both the quality of harvested fruits and disorders of the musculoskeletal system of workers during the harvest (Mlotek, 2015) [6]. A high stress on the human motoric system is observed when the picker is holding a container of fruit (basket, bucket) with one hand and picking fruit with the other hand (Mlotek, 2015) [6]. Moreover, considerable neck pain has been reported during harvesting of fruits situated at the upper periphery of the tree. Therefore, the worker cannot harvest continuously (Mlotek, 2015) [5].

Materials and Methods

Developed telescopic fruit harvester cum pruner consists of Telescopic shaft which is having maximum length of 23 meters. 13 shafts are fitted for getting height of 23 meters and the outer most (lower shaft) diameter is 60 mm and that of the inner most is 16 mm. these shafts are fitted with the flips with locking clamps diameters as inner diameter 18 mm to 45 mm with wall thickness of 3 mm and outer diameter as 27 to 54 mm.

Corresponding Author:**Geeta S Bhumare**College of Agricultural
Engineering and Technology,
VNMKV, Parbhani,
Maharashtra, India



Fruit Harvesting Blade

Fruit harvesting blade is made from high carbon steel with width of operation as 145 mm, and thickness of blade is 2 mm. This provided with clip which is fitted in the top inner shaft.

The material of the shafts is Carbon Fibre High Modulus Tubes and tube-to-tube fully interlocking. Electricity cut-off slides and insulation coating provided, However strictly recommended to operate away from electrical lines are provided for safety.

Performance Evaluation of telescopic Pruner cum fruit harvester

In the field of KVK, the tool was tested for its performance as Average time to set the blade, extension of shafts and retracting height of shaft, interchanging of tress, size of pruned samples. Number of fruits harvested per hour.

Table 1: Field performance of Developed pruner cum harvester

Sr. No.	Particulars	Range
1	Names of trees	Coconut, Areca, Teak
2	Average time taken for fixing/removing the pruning blade, seconds	8.74 - 10.90
3	Average time taken for extending the height of pole, seconds	9.78 - 12.12
4	Average time taken for retracting the height of pole, seconds	7.5 - 10.39
5	Average time taken for interchanging the tree, seconds	12.33 - 18.75
6	Average time taken for picking and pruning the tree, seconds	40.23 - 74.58
7	Average time taken for picking and harvesting the fruits, seconds	37.39 - 85.64
8	Average size of pruned samples, mm	87.3 - 208.5
9	Total number of trees pruned during the test	41 - 54
10	Total number of trees harvested during the test,	49 - 65
11	Average number of trees pruned in one hour, trees/h	7 - 10
12	Average number of trees harvested in one hour, trees/h	7 - 11
13	Average height of tree pruned, m	10.90 - 15.24
14	Average height of tree harvested m	17.56 - 22

The number of tree pruned in one hour was observed in range of 7 to 10. The number of tree picking and harvested in one hour was observed in range of 6.5 to 11. The time required for extending the height of pole was observed as 8.74 to 10.90 seconds. The time required for retracting the height of pole was observed as 7.5 to 10.39 seconds. The time required for fixing/removing the pruning blade was observed as 8.74 to 10.90 seconds. The time required for interchanging the tree was observed as 12.33 to 18.75 seconds. The time required for picking and pruning the tree was observed as 40.23 to 74.58 seconds. The height of tree pruned was observed in range of 10.90 to 15.24 m. The height of tree harvested was observed in range of 17.56 to 22 m. The sizes of pruned samples were observed in range of 87.3 - 208.5 mm. The maximum height of tree pruned

was 15.24 m. The maximum height of tree harvested was 22 m.

Ergonomically Evaluation

The ergonomically evaluation of the tool was also carried for heart rate, Energy Expenditure, Body Part Discomfort and overall discomfort rating of the operator. Three subjects from different age groups and body structure were taken for observations. The selection was done from the anthropometric data available with department of farm Machinery and Power, College of Argil. Engineering and Technology, VNMKV, Parbhani.

Heart rates were recorded with heart rate monitors during the experiments conducted for all subjects selected. The corresponding values of oxygen consumption (Vo_2) of

subjects were predicated from calibration charts of corresponding subjects.

The selected subjects were calibrated as per the procedure mentioned in the materials and methods.

Table 2: Ergonomically Evaluation of developed pruner cum harvester

Parameter	Areca nut/saphota			Coconut		
	S1	S2	S3	S1	S2	S3
Heart Rate	86	88.4	91.5	130	136	142
Oxygen consumption	0.57	0.577	0.588	1.12	1.26	1.341
Energy Expenditure	11.90	12.05	12.28	23.38	26.31	28.00
BPDS	66.2	68.7	70.7	90	92.3	94.8
ODR	2.3	2.8	3.1	3.1	3.6	4.1

From the table it is observed that heart for coconut harvesting was higher to 142 with oxygen consumption of 1,314 lps. This is due to balancing of shaft while harvesting at greater heights. The same trends observed rearguing body part discomfort scores and overall discomfort rating. From the analysis of the data, work is of moderate to heavy type with less risk of accidents while harvesting and pruning. The operator can easily adjust the height of telescopic pole by extending and retracting the pole accordingly branch height. The height of pole was locked after attaining the required height. The speed of operation was depends on adeptness of the labour. No noticeable difficulty was observed during the operation.



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