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VIBRATION ANALYSIS OF TRACTOR MOUNTED HYDRAULIC ELEVATOR

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ABSTRACT

In Due to increase of height of horiticultural crops it is difficult to harvesting and pruning. Some equipments & hand tools are available in market for harvesting and pruning, but those tools are non-useful for harvesting due to untrained labour, taller trees & high cost of equipment. Some mechanical equipments & machines are available in market for this purpose but this equipments & machines are very costly and require large space for holding hence it is very difficult to harvesting pruning of horticultural crops. Some skills are required for labours to climb on trees by using this the available equipment hence to overcome & reduce this problem Tractor Mounted Hydraulic Elevator (TMHE) power by tractor PTO was tested for the mechanical harvesting and pruning of crops using digital load cell, Vibration meter, and digital Technometer for elevator stability study and pruner engine RPM measurements while in branch cutting respectively. The testing and performance of the above machine was carried out on various crops at Dr. BalasahebSawantKokanKrishi, Vidyapeeth. Performance of various machine ws tested for various varieties of crops.

The study of vibration measurement has been done using vibration meter. The vibrations of harvesting bucket are measured during rising and lowering action of harvesting bucket. Also the frequency analysis of elevator upper arm was studied by using theoretical methods. The study shows that, the minimum vibration acceleration and velocity are observed at 5-meter height.

The field testing of Tractor Mounted Hydraulic Elevator was conducted on Mango orchard at horticulture department, Dr. BSKKV, Dapoli, for different varieties. The average weight of fruits harvested per hour using Tractor Mounted Hydraulic Elevator was 58.84 kg/hr.

KEYWORDS: Harvesting, Load Cell, Pruning TMHE, Vibration Meter.

INTRODUCTION

Large Number of fruit and vegetables are grown in India due to well agricultural land in India. Due to well agricultural land in India. Due to production of large No. of fruits and vegetables India is at top most position for exporting high quantity of fruits & vegetables. The total production of fruits and vegetables in the world is near about 400 meter. Out of this India is producing 32 meter Output. The major fruits in the India are mango, banana, apple, pineapple, papaya, and grapes konkan region is famous for production of mango, kalipattisapota fruit and shrivardhance variety of are count out of these many fruits are grown in rainy season. Kokan region is the India hence there are varieties of mangoes are found in the kokan region. Alphanso is a very famous variety of mango fruit all over the world also the coconut trees are available in large quantity in kokan region. Along with mango coconut trees are available in large number in that region. The coconut production and plantation was increasing consistently for last 40 years. The manual harvesting of this fruits is very difficult and time consuming hence during peak season, it is not possible to get required number of skilled labour. Due to difficulties observed in this operation the quantity of skilled labours is going to decrease in recent days. To overcome this difficulty Dr. BabasahebSawantKokanKrishiVidyapeeth, Dapoli developed Tractor Mounted Hydraulic Elevator (TMHE) for harvesting and pruning of such type of fruits. Tractor Mounted Hydraulic Elevator is used for harvesting and pruning of fruits up to 12 m height of tree. The control panel attached to the lifting platform, controls the height, position and angle of rotation & vibration of tractor mounted Hydraulic Elevator.

LITERATURE REVIEW

India is manufacturing large quantity of fruit and vegetables accounting about 60% of word production. The export of fresh fruits are limited to Alphonso&Dashehari varieties of mango.The tractor mounted hydraulic lifter for harvesting pruning and spraying of horticultural crops upto 12 m by applying the product development cycle. Nevertheless, the trees taller than 6 m are difficult and not economical for harvesting, pruning and spraying, by considering the labor cost and time. These problems were eliminated by the tractor mounted hydraulic elevator. The machine was very much suitable for harvesting and other allied operations of horticultural crops. The testing of the machine was carried out for harvesting and pruning operations for Mango and Coconuts orchards. (Kolhe, 2009a; 2009b) the stability and the ergonomic design considerations of the tractor mounted hydraulic elevator were studied for the future development of the machine. The better stability results with the controlled vibrations and frequency of the lifting platform and welded joints were recorded by keeping constrained boundary conditions. Ergonomically operational safe and 3 controlled heart rate was recorded. Consequently, the labors can continuously do the coconut harvesting work by using the tractor mounted hydraulic elevator. The minimum PTO power was recorded for the coconut harvesting by using tractor mounted hydraulic elevator. (Kolhe et al., 2011; Kolhe and Jadhav, 2011).

The problems of machine stability, operating mechanism, human safety and harvesting reach in the tractor mounted hydraulic elevator were noted. By considering the problems of the existing prototype tractor mounted hydraulic elevator it was decide d to develop the tractor mounted and self propelled coconut climber. The machine was designed and developed with the financial support of Coconut Development Board, Ministry of Agriculture and Government of India (Fig. 1). Ergonomics is the tailoring of products, so that the human user involved is as comfortable as possible with minimized stress and fatigue. Health, safety and productivity benefits often result from this worker friendly approach. Most designer of agricultural equipment concentrated to improve efficiency and durability, but none seem to give importance to the operator comfort. Generally, the operator is only a part of the machine system. The fit between a person and a farm implement is not typically an issue for short-term users, but becomes more critical for long term users. Long term users historically report a great deal of discomfort or pain (Corlett and Clarke, 1976). The farm tools used in agriculture were estimated about 800 millions. Though there were a good number of agricultural hand tools developed in the State Agricultural Universities and other institutes for better output, they were rare in use except in very few cases and the farmers were still using age old traditional hand tools and methods because of its versatility and adoptability. fruits are less prone to stemend and other storage diseases (Sapovadia et al., 2001). Fadal (2005) Conducted study on Development of a tractor-mounted date palm tree service machine. Two outriggers support the base and other system components to avoid excessive tire pressure while machine is in operation. The base carries a rotating joint in its middle, where a horizontal hydraulic cylinder is used to swing the joint, and the elevator-platform assembly accordingly. Two control panels are installed to control the machine. One of them is located on the base unit, where it may be used from the ground, and the other one is located on the platform to be used by the operator on top. The ground controller controls the out riggers, raising, lowering or swinging the platform. On the other hand, the second control panel, which is placed in the platform where the controller has the ability to control the whole system, including the winch located on the platform. Conducted studies on Mechanical Harvesting of Almond with an Inertia type limb shaker. Mira et al. (2008) Conducted studies on Design, construction and testing of an apricot tractortrailed harvester.

In this harvester the two articulated arms at the rear of the chassis, and the wheels are attached at the end of these. These arms move independently on a vertical plane, each of them motioned by a hydraulic cylinder. This movement, combined with the tractor's elevator system, allows for the harvester's leveling in the longitudinal and transverse directions. The trailer's maximum height over the ground is between 0.2 and 1.22 m. This higher clearance allows the unloading of apricots into the boxes or box pallets with a minimum dropping height, preventing fruit damage. The arm-wheel hydraulic cylinders are operated by the tractor's external oil system. Hydraulic controls are located on the left rear side of the trailer. A person walking next to the harvester with a manual branch shaker could also control the trailer hydraulics. The mango harvesting was carried out by pluck-and-drop method with a rod of 3 m long pole with a hook at the end. The pole and collection bag method consist of a plucking technique using a rod of convenient length (1-2 m) equipped with a collecting bag near the hook. The plucked mangos were gathered and selection was made to minimize variation in the sizes. Kolhe (2009) has design and developed a tractor mounted hydraulic elevator for the mechanical harvesting, pruning and spraying of horticultural fruit trees. The testing of the above machine was carried out for harvesting of mango and coconut orchards upto 14-meter height.

The comparative study of the TMHE with other available elevators was studied from the literature. The TMHE noted the most suitable results for the harvesting of mango and coconut orchards. The present study was conducted for the stability

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analysis of tractor mounted hydraulic elevator for various height of Lifting Platform from ground surface and angle of rotation of the tractor mounted hydraulic elevator for harvesting and pruning of Mango Orchards. Where as the performance of TMHE was carried out to predict the actual field capacity of the above machine for harvesting and pruning of Mango orchards.

MATERIALS AND METHODS

The experimental setup for tractor mounted hydraulic elevator is as shown in fig. 1a & b**.**

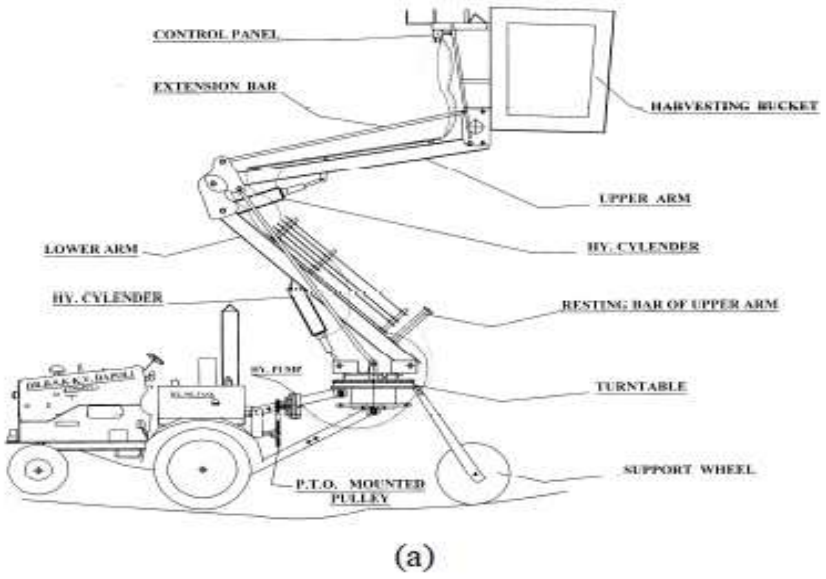

Fig. 1a: Design of Tractor Mounted Hydraulic elevator for harvesting, Pruning and Spraying of Horticultural Crops.

The theoretical analysis of the elevator was carried out by using varying weights of 25 kg., 50 kg, 75 kg, 100 kg, 150 kg & 200 kg respectively the vibration of machine for particular load is tested during the testing. The overall test was carried out for same height but with varying load & by using load cell vibration is measured.

Fig. 1b)Tractor Mounted Hydraulic elevator for harvesting of Mango orchards.

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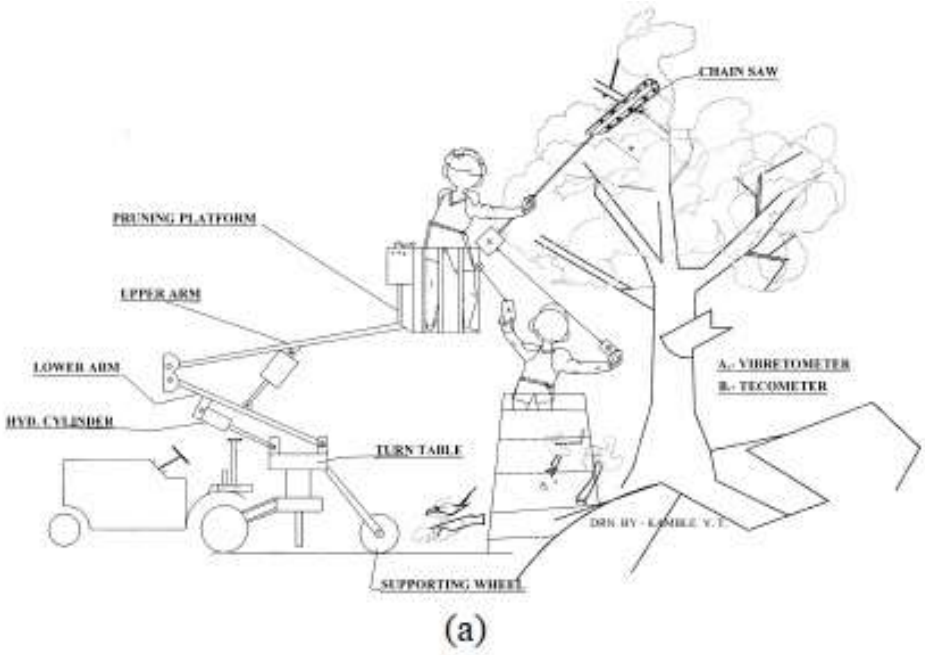

Fig. 2: (a) Experimental Set up of TMHE for Mango Pruning

The load cell was placed in middle of load cell guiding device in such a manner that the total load of tractor act on the S-beam of load cell. The load cell with load guiding device was kept below the left rear wheel of tractor and the another load cell guiding device without load cell was placed below the right rear wheel of tractor for proper balancing of both wheels. The experimental setup of stability analysis is shown in Fig. 2. The experiments were carried out in different stages by changing the operating parameters of the elevator. Stage 1: In this stage the height of elevator from ground surface was kept constant at 1.4 meter. The load inside the bucket was kept 50 kg, for set of this condition different reaction on tractor rear wheel were noted on strain gauge display panel by changing angle of rotation from 0-360° at an interval of 30°. For this set the load was varied from 75, 100,125 and 150 kg respectively.

In this stage the height of bucket is increased up to 1.7 m and for varying loads of 50, 75,100g, 125 and 150 kg with varying angle of rotation from 0-360° the reaction on left rear wheel of tractor were noted from digital display panel of load cell. Similar types of experiments were repeated for 2.5,4 and 6 m height of lifting platform. And the reaction on left rear wheel of tractor was noted on digital display panel of strain gauge. The field performance of TMHE for mango harvesting was conducted on plot No. 13 and 15 of university horticultural mango plot for 18 trees of various mango varieties like Suvarnrekha, Totapuri andAlphanso for finding out the weight of fruits harvested in kg and field capacity of the elevator. The experimental setup of above elevator for Mango harvesting is presented in Fig. 1b.

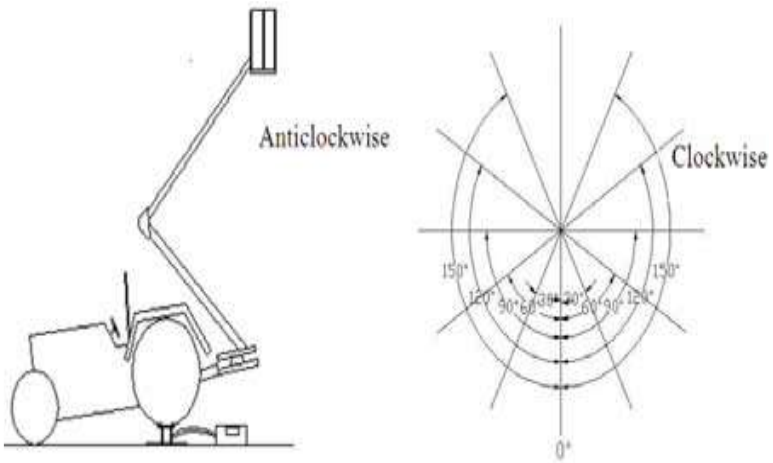

Fig.3: Experimental setup for testing the stability of TMHE.

RESULTS

The results of stability analysis of Tractor Mounted Hydraulic Elevator, using digital load cell for different angle of rotation of turn table in clockwise and anticlockwise direction are presented as in Table 2. From Table 2, for fixed load of 50 kg and harvesting platform 1.4 m, if the angle of rotation of turn table increases in anticlockwise direction, the reaction on tractor rear wheel decreases. Whereas for the same conditions, if the angle of rotation of turn table increases in clockwise direction, the reaction of tractor rear wheel increases.

Table 2: Reaction on left rear wheel of Tractor in Clockwise direction

SR. No.	Load (Kg)	Height (m)	Reaction on left rear wheel of tractor, Kg Clockwise					
			Ø=0°	Ø1=30°	Ø2=60°	Ø3=90°	Ø4=120°	Ø5=150°
1	50	1.4	395.2	398.3	401.6	404.2	406.7	409.5
	75	1.4	398.6	4010	402.0	404.0	405.0	407.5
	100	1.4	399.4	400.7	403.0	405.6	406.8	407.9
	125	1.4	400.2	402.3	405.3	406.2	407.5	407.6
	150	1.4	402.4	404.3	405.8	407.3	408.3	409.2
2	50	1.7	398.4	399.9	402.3	405.2	407.4	409.7
	75	1.7	401.7	403.2	405.8	406.1	408.7	410.3
	100	1.7	403.8	405.7	407.6	410.4	412.6	412.8
	150	1.7	404.7	406.0	408.2	410.8	413.2	414.5
	150	1.7	405.9	407.8	409.3	411.2	413.3	415.2
3.	50	2.5	400.1	402.0	403.8	406.2	408.3	410.8
	75	2.5	402.3	404.1	406.4	407.8	409.3	411.2
	100	2.5	404.5	406.2	407.8	409.3	411.5	413.4
	125	2.5	406.4	408.4	410.1	412.3	415.3	416.8
	150	2.5	408.6	410.7	411.8	413.2	416.3	418.1
4.	50	4.0	402.7	404.1	405.8	407.1	409.0	410.0
	75	4.0	404.5	406.0	408.3	409.9	411.5	413.4
	100	4.0	406.8	408.6	410.2	412.3	414.3	415.8
	125	4.0	408.2	410.7	411.4	413.6	416.3	418.6
	150	4.0	410.3	413.0	415.8	419.2	420.3	422.3
5.	50	6.0	403.6	405.2	407.4	409.9	411.3	413.8
	75	6.0	404.8	407.3	409.5	412.0	416.3	418.2
	100	6.0	406.2	409.9	411.7	414.0	415.9	421.0
	125	6.0	408.4	412.3	414.2	416.2	418.3	422.3
	150	6.0	410.7	412.3	415.1	417.2	419.5	422.8

DISCUSSION

For better stability of the elevator minimum variations in the reaction are needed. Hence for obtaining the minimum variation of reaction it is recommended to use the machine on plain land while in operating condition. Performance of tractor mounted hydraulic elevator for mango harvesting: From the Table 4 and 5, the maximum and minimum time for Totapuri mango variety noted is 512 and 222 for 10.1 m and 9.81 m tree height for harvesting of 72 and 32 mangos respectively. Whereas for Suvarnrekha the maximum and minimum time noted was 488 and 392 seconds for tree 10. M and 10.75 m tree height for harvesting of 408 and 337 mango respectively. Similarly for Alphanso mango variety the maximum total time of 408 and 357 sec for 9-9 and 9.75 m tree height for harvesting of 80 and 50 mango respectively. It

is also observed from the above study that the lifting and lowering time is proportional to the height of mango tree. Nevertheless, the total harvesting time is mostly depends upon the total no of mango incorporated for the individual tree.

CONCLUSION

• The overturning of the elevator is not observed, up to 12 meter height of tree from ground including 150 kg load in the lifting platform • The average lowering time required for harvesting bucket to lower down from height of 10.04 m was 28 sec

• The hydraulic elevator is suitable for harvesting of mango and coconut orchard upto 12 m and pruning of tree up to 10 m height comfortably.

• The hydraulic elevator is suitable for operation on plain field as well as hilly terrain having slope upto 20.5%

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