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Tractor Mounted Hydraulic Ladder for Mango Fruit Harvesting

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Abstract

A tractor-mounted hydraulic operated ladder developed to reduce the harvesting/ pruning costs, increase the harvesting/ pruning efficiency and enhances the overall productivity of mango orchards. The hydraulic ladder was evaluated in the actual field condition and it was observed that it can be rotated from 0 to 360 degree both in clockwise and anticlockwise direction so that minimum 4 mango trees can be covered by simply operating the directional valve. The hydraulic ladder is suitable for harvesting of mango upto 12 m, pruning of tree up to 12 m height comfortably and spraying over the tree canopy up to a height of 12 m. The cost of operation of the hydraulic ladder (Inclusive of tractor) for harvesting mango is Rs. 4,240.00 /day.

Introduction

n India, fruit harvesting is commonly done by experienced tree climbers. Fruit growers in the developing countries are facing two significant problems that could determine the future of their business. The availability of fruit harvesting labour dwindling every year and the supply of hand fruit pickers continues to shrink. In addition, there are fewer workers available to harvest fruits because of continuous outflow of workers from agriculture to better paying jobs in construction and industry (Blank, S. C., 1998). Since the cost of manual labour is constantly rising, the only way to maintain or reduce the labour cost is to increase the productivity of lab markets (Holt, J. S., 1999). Brown, G.K. (1983) showed that among cultural operations, harvesting, pollination and pruning are the most labor intensive work accounting for more than 80 percent of the total production costs. In fruit orchards, the cultural operation methods involve traditional and mechanical methods. The current system for picking and pruning fruit trees is labor intensive and physically demanding. Workers must be able to move, position, and climb ladders to reach fruit located up to 45 feet high. Workers can be burdened by as much as 150 kg of fruit while performing these tasks, which demands workers, be physically fit. Bearing this weight while on the ladder also poses huge safety risks to the workers.

Hence, mechanization is the only answer, since it offers potentially the only option for reducing harvesting labour expenses. Thus, mechanization plays a vital role in securing the future of fruit growers in the developing countries. The most popular cultural operations carried out in orchards are the following: pollination, dehorning, pruning, fruit thinning, bending and bagging of bunches and pesticide control.

Development of Tractor Mounted Hydraulic Ladder for Mango Fruit Harvesting

Based on the requirement, a tractor mounted hydraulic ladder for mango fruit harvesting has been developed. The Specifications of tractor mounted hydraulic ladder for mango fruit harvesting is presented in Table 1.

Table 1: Specifications of tractor mounted ladder

| S. No. | Details | Value |
|--------|---------------------------------------|--------------------------------|
| i | Over all dimensions, (L × B × H) m | 6 × 3.5 × 4.8 |
| ii | Trailer size, m | $2.72 \times 1.71 \times 1.56$ |
| iii | Gear box size, m | $0.35 \times 0.35 \times 0.32$ |
| iv | Cage size | 0.75 × 0.75 × 1 m |
| v | Rotation, degree | 0 to 360 |
| vi | Maximum Cage load, kg | 300 |
| vii | Minimum Height, m | 4.0 |
| viii | Maximum lifting height, m | 12 |

Evaluation of Tractor Mounted Hydraulic Ladder for Mango Fruit Harvesting

The developed hydraulic ladder is trailed type and it was hitched to a 40 hp tractor and operated by the tractor PTO through cardon shaft's one end is connected to the tractor PTO and other end to the pump. The total lifting height of the developed hydraulic ladder is 12 m (40 feet) and it is able to rotate 360 degree on both clock and anticlockwise directions. Trials have been conducted with the developed tractor mounted hydraulic ladder in the mango orchard of University Research Station. The operational view of the developed tractor mounted hydraulic ladder for mango fruit harvesting is shown in Figure 1. The results of the mango harvesting operations are given in Table 1.



a) 0 degree



b) 90 degree



c) 180 degree



c) 180 degree Figure 1. View of the developed hydraulic ladder at different rotation angles



| Table 2: Field trial for mango fruit plucking and other operations (mean value) | | | |
|---|---|----------------|--|
| SI. No. | Particulars | Values | |
| 1. | Location | Institute Farm | |
| 2. | Average height of the tree, m | 6 | |
| 3. | Average time for lifting the bucket, s | 12 | |
| 4. | Harvesting Capacity, kg/h (Rajgira variety) | 130 | |
| 5. | Harvesting efficiency, % | 79 | |

From the evaluation it is concluded that the mango harvesting capacity of the refined hydraulic ladder is 130 kg/h to 147 kg/h for Rajgira variety. The hydraulic ladder is developed in such a way that it can be rotated from 0 to 360 degree both in clockwise and anticlockwise direction so that minimum 4 mango trees can be covered by simply operating the directional valve. The cost of operation of the hydraulic ladder (Inclusive of tractor) for harvesting mango is Rs. 4,240.00 / day. The hydraulic ladder is suitable for harvesting of mango fruits, pruning and spraying over the tree canopy up to a height of 12 m.

Conclusion

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