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Review on Design and Development of Pesticide Sprayer For Arecanut Tree

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Abstract

Areca nut is one of the major commercial crops grown in Southern parts of India. During the rainy season the arecanut crop gets attacked by disease due to fungi. This makes the half grown arecanut crop to decompose and fall. The major concern in this sector is the lack of skilled labor and safety issues for spraying pesticides and harvesting. Currently, the pesticide spraying is done manually by climbing the tall trees. This is much difficult, risky job, because the person has to climb the tall tree, which is also slippery in rainy season. To avoid the risky job, in this project a supporting lightweight small plate at the operating level just above the ground, centrally carries a long pipe. This plate is supported between two arecanut trees by flexible ropes and springs. The sprayer fixed at the top can be controlled from the ground level. The long pipe carries the pressurized pesticide from ground to the top, which is to be sprayed to the half-grown bunch of arecanut fruits. This project idea helps in such ways that, the person need not to climb the tall tree, but he can spray the pesticide by standing on the ground itself.

Key Words: Agricultural, fibre plate, Pesticide, Portable, Polyvinyl chloride

1. INTRODUCTION

Number of researchers developed various techniques and devices intended to climb the tall areca nut tree for spraying pesticides or for garnering the crop, etc. In rainy season the half-grown arecanut crop suffers from a fungal disease due to heavy rain. To save the crop from fungal attack, it should be sprayed with pesticides. But spraying the arecanut situated at tree-top which is about 15m is a risky and difficult task. Due to continuous rain, the tree surface becomes slippery to climb. In the past, the pesticide spray was done manually by climbing the tree. Due to labour shortage and non-availability of skilled labor, people started developing machines to avoid the tree climbing manually. Many researchers have developed devices using different ideas and designs. Each researcher used typical mechanisms in their device for climbing the tree. Some have used mechanical linkages and working without electricity, some others have developed semi-automatic tree climber and plucker attached with machine vision. The safety of the climber was on focus and many have avoided manual tree climbing in their device. Whereas some have developed automated robotic pesticide sprayer for arecanut. Few researchers developed a drone for arecanut harvesting successfully. Attempts were also made to develop an arecanut tree climbing device using fuel engine which can move vertically up or down along the by remote control.

2. LITERATURE REVIEW

A literature review of articles about arecanut tree climber and pesticide sprayer is carried out is given below.

R. Thirupathi et al.,[1] in their project developed a climbing machine which has spring and pulley and harvest the nut. The developed device is fully depending upon mechanical linkages and spring actions without electricalpower. Mohit Rane et al.[2], proposed a semi-automated tree climber and plucker machine which can climb and harvest. The device has wirelessly controlled and a machine vision is provided by a camera to get clear vision of the crop at high altitudes. This machine eliminates the need of tree climbing manually and hence operator safety is increased and fatigue is reduced significantly. Sudarshan

Doiphode et. al.[3], developed an Automated Pesticide Sprayer for Arecanut. In this the motor rotates the roller. Due to friction between the roller and surface of tree, the robot can ascends. Robot's upward and down ward movement along the tree can be controlled and stopped at any required height by mobile app. A Direct current motor provides 180 degree rotation to an arm carrying two sprayers. Nallusamy.V, N.Shrivathsan et al,[4], proposed a novel tree climbing robot which is composed of a pair of Omni directional tree grippers for holding the robot on a tree surface and a novel 3 DOF continuum manipulator for the manicuring. Ahmed Salih Mahdi. Al-Zuhairi [5] have designed and developed a robot which can climb or move downward along the tree with diameter of range 15 cm to 25 cm. N S Kannur[6] designed a model that can timely grip and release the long areca nut tree by two metal wire ropes locked to the moving frame. Rahul V, et al.[7] have developed a prototype device to climb coconut trees, which can perform multiple operations such as pluck coconuts, clean the tree top and to spray pesticides. The device is reliable and easy to operate. Sathishkumar C et al, [8], designed an arecanut tree climber which is a safe, reliable, efficient and avoids the risk in climbing the arecanut tree. The model developed has compression springs. The spring gets compressed by the tension produced on the ropes over the pulley. The compressed spring holds the potential energy in the compressed state of the spring. The releasing of rope decreases the tension in the pulley and now the potential energy stored in the compressed spring is now turn into expansion stage and thus the potential energy is converted in to kinetic energy and thus creates a movement over the parts of the product. Sri Krishna Shastri C and Megha B,[9] proposed an areca tree climbing device which has synchronized motors so that the machine efficient operations. The motors are controlled using headlamp relays since the motors are of high current ratings. Headlamp Relays will be controlled by 4-channel SPDT relays and these SPDT relays can be controlled by a controller through a Bluetooth command which can be sent through a smart phone. Arunkumar S M et. al.,[10] have designed and fabricated an areca nut tree climbing device. It can be used for spraying pesticides as well as for crop cutting at an height of 60 feet or more. The device has an L-shape base frame and fitted with petrol engine, nylon tyres with rubber grippers. It has a remote controlled spraying unit. Power from the petrol engine is supplied to the wheel climbing an areca nut tree as well as spraying unit. Jananesh Bekal et al. [11], The device is battery operated and has a X frame and two conical shaped rollers which provide wedge action between the tree surfaces to maintain a robust contact. It also consists of an arm which can rotate at a 360 degree. The operator at the ground can control the movement and rotation of the system. The demerit of the device is that it is restricted up to the spraying of pesticides at visible height. Rakesh B K et al. [12] successfully used drone for arecanut harvesting. Arjun Prasad et al. [13], has designed a harvester which uses friction to hold the palm tree due to friction and by compression springs. It can hold the tree firmly at variable trunk dimensions of the tree. The system is fitted with a video camera to locate the position of crop on the tree. This camera is coupled with a Zig-bee microcontroller and X-bee RF module to control the machine wirelessly. Fasil TK et al. [14], have designed a machine which works on the principle of rope pulley system. A drum welded with a shaft winds the steel rope around the tree. The spring gets contracted due to winding. The spring force acts opposite to the direction of the applied force. This generates an upward motion. A rope tied on to lower and upper rings help to climb down the tree. When the rope is pulled down, the system comes down in a steps with the help of the rings. M.Tony et al.,[15] have tested the system for its performance and found safe, reliable, and efficient and also reduces the problems in climbing and spraying arecanut tree to a good extend. Sharana Basavaraja et al. [16], have proposed a device which has two units RH and LH. The downward movement of the pedal is done through RH Unit. The steel wire rope stretch and locks the areca nut tree. Now the LH unit is moved up by pulling the handle, to climb and the same process is repeated to reach the required height. Abhishek Chakraborty and Shivam Sharma [17], The authors have used single cylinder two stroke engine. The engine speed can be varied using accelerator pedal. Their research proved that the size of main jet is crucial for better results under various load and gear operating condition. Shwetha B & Bhaskar B [18] designed a smart sprayer and tested for arecanut trees of various diameters. The up and down movement of the smart sprayer on the tree and can carry the sprayer nozzle are totally controlled by a remote control unit. Atreya G Bhat[19] has designed a light-weight Semi-Autonomous Robot which can climb the areca tree with a single high torque driving motor. He used a Laser guided servo-controlled nozzle to spray the pesticides.

Pictorial Views of Various types of Tree climber devices developed with Pesticide spray/ Crop cutter mechanisms for arecanut tree are shown below.

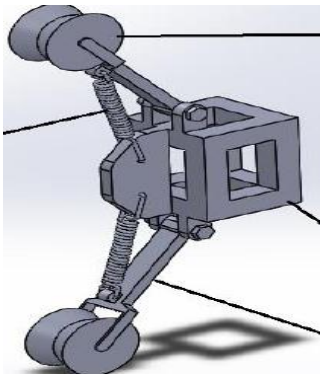

Figure 1. Semi-Automated Areca-Nut Tree Climbing Plucker [2]

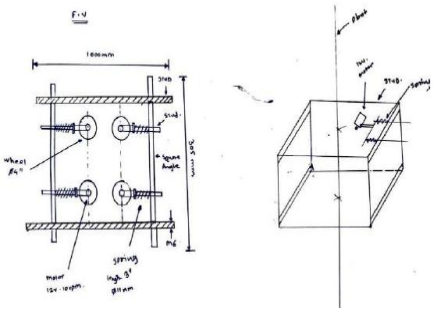

Figure 2. Schematic of Automated Pesticide Sprayer for Arecanut [3]

Figure 3. Conventional method of spraying Pesticide for Arecanut [3]

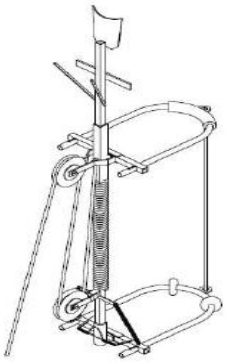

Figure 4. Schematic of Arecanut climbing & harvesting Machine [8]

Figure 5. Tree climber set up [9]

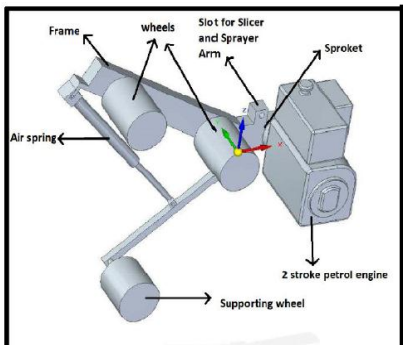

Figure 6. Remote Operated Device for Removing the Bunch of Areca Nut from the Plant and Spraying of Pesticide [10]

Figure 7. Arecanut Tree Climbing and Spraying Machine [15]

Figure 8. Smart Pesticide[18]

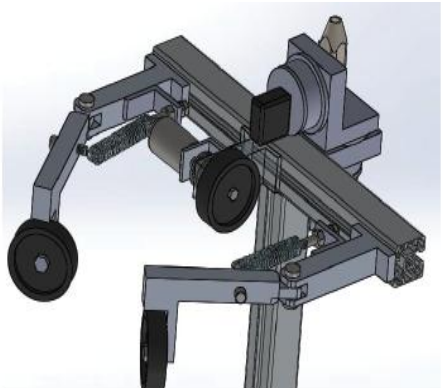

Figure 9. Isometric view of automated tree climber[19]

Figure 10. Arecanut cutter and sprayer[20]

Figure 11. Robotic Sprayer[21]

2.1 Summary of literature:

Many researchers have developed devices using different ideas and designs. Each researcher used typical mechanisms in their device for climbing the tree. Some have used mechanical linkages and working without electricity, some others have developed semi-automatic tree climber and plucker attached with machine vision. The basic requirement is the machine should be reliable and robust to work in rough field conditions. The devices with complex and sensitive electronic systems should be protected from wetting by pesticides during the spray or by water during rainy season. Device should be robust against common impacts during the usage in the field. Practically, there are merits and demerits in each device developed. Some devises are bulky, some need external power to operate, and some devices are too delicate or not reliable. Some devices developed are heavy and may damage the tree when the device moves up and down. Some other devices are costly and complicated to use in the arecanut farm during rainy season. It is the need of the hour to overcome some real time issues and demerits. There is still vast scope for new designs of arecanut tree climber and harvester.

2.2 Methodology:

Project setup consist of the base, It is placed between 4 to 5 areca nut trees or more to cover the more number of trees within that radius of rotation. At the beginning the clamps are installed between 2 to 3 trees about 2m above the ground level and these clamps are then fixed with hook springs. The fibre plate connected with rope and spring to hold the plate.. Both the stand and the fibre plate acts as a support structure to the Polyvinyl chloride (PVC) pipe of small diameter (length-15m) which is then installed into the system. Before the installation of PVC pipe into the system, sprayer of the hand pump is connected to the top end. For the liquid mixture of Bordeaux to reach the required height, a high-head pump is used. This device is portable and there is no need of any skilled labours to operate it.

3. CONCLUSIONS

A good number of researchers have worked to solve the issues of pesticide spray or cutting the crop at top of arecanut tree by developing various machines using different concepts. Depending on the complexity of the device, its cost also varies from one device to other. A simple Design for pesticide spray is the urgent requirement. The device should be easy to operate, should be light weight, work without use of electrical power or not run by internal combustion engine. At the same time the device should be less costly, robust to use in rainy conditions, should have less electronic components and free from corrosion. The frequent movement of the device along the tree should not damage the tree surface. There is scope for developing a device with few kinematic mechanisms and which may not require to climb up for pesticide spray to arecanut tree.

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