The Pharma Innovation Journal 2019; 8(11): 152-155

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(11): 152-155

www.thepharmajournal.com
Received: 13-09-2019
Accepted: 15-10-2019

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Advance techniques for arecanut harvesting

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Abstract
In recent years, labour scarcity has emerged as one of the foremost challenges in farming. Tall tree farming such as arecanut, coconut, palm etc. are most affected trees for its harvesting. Arecanut tree climbing has been tenacious job besuase of manual climbing pratices without any support therefore, having probability of accidents are more. Highly skilled labours are requried for performing sucessful harvesting and other intercultural operations for arecanut farming. But due to shortage of skilled labours causing delay in such operations leads to increase in wages of labours and it finally affects total farming cost of areacanut growers. This study paper presents details of traditional methods and developed tecniques to solve issue of arecanut tree climbing and harvesting. The study gives better harvesting technology which can reduce harvesting cost and give benefits to arecanut growers.

Keywords: Arecanut, climbing, harvesting, meacanical tools

Introduction
Arecanut (*Areca catechu* L.) is major cash crops in humid tropics of India. The areca nut palm is the source of the common masticators nut, popularly known as areca nut. It is a delicate tropical palm reaching a height of 30 to 60 meters and has a long life of 60 to 100 years. In India, areca nut is largely used as a masticatory, being chewed with betel leaves (piper betel) and a little slacked lime. This practice, of chewing betel leaf, is believed to strengthen gums and helps digestion, Areca flourishes in regions with heavy rainfall and high humidity. The quality, variety, and types of arecanut vary from one place to other. Arecanut is produced in two types
1) White chali type arecanut,
2) Red boiled type arecanut.

White chali type arecanut: It is prepared by harvesting of the fully ripened fruits and drying them in sun for around two months.

Red boiled type arecanut: It is produced by harvesting the green nuts and peeling off the outer husk and then by boiling them.
Areca nut is one of the most important commercial crop in the Southeast Asia popularly known as betel nut or supari, areca nut. Major areca nut producing countries of the world are India, China, Myanmar, Indonesia, Thailand, and Bangladesh. The average yield level is 1.5-3.0 kg palm^{-1} in arecanut in West coast region of India (Horticulture Statistics Division). In the tropical belt where arecanut grown (28^{o} N and S of equator), precipitation is confined to six months from June to November with average rainfall of 3700 mm. India contributes an area, production and productivity of arecanut is about 466200 ha, 73000 MT and 1.6 MT/ha, respectively. total area under areca nut is around 466160 ha and the total production is around 729970 MT (Badhe *et al.* 2010) [1]. Kerala and Karnataka account for about 70 per cent of country's production. Other leading states for arecanut cultivation are Assam, Meghalaya, West Bengal, Tripura, Tamil Nadu, Mirzoram,Maharashtra,Nagaland, Andra Pradesh etc. In Maharashtra, area and production of arecanut is about 2300ha and 3500MT, respectively. It is an important garden crop in Konkan being raised in mixed gardens.
It is mandatory to climb areacanut tree yearly for a successful harvest and for the preventive spray against disease and pests. Only skilled labours can carry out these farming operations. They have to climb the trees using muscle power. As such type of work involves real hard, physical exertion. The regular climbing on areca trees or other intercultural operations which are done manually to large extent requires specialized labours. Hence, younger generations of labours are losing interest for areca nut cultivation.

If the drudgeries and risky job of climbing on tree is avoided, by some means/gadget/mechanism, it will be most appropriate solution for the current problem of areca nut growers.

Methodology
Cultivation practices
Climate and soil
Arecanut requires abundant and well distributed rainfall. It grows well within the temperature range of 14-36 °C. It can be cultivated up to an altitude of 1000 m in deep and well-drained soils with low water table. Laterite, red loam and alluvial soil ' are most suited.

Raising planting material
Mother palm should be more than ten years old with early bearing nature and with good fruit set. Fully ripe nuts weighing more than 35g should be selected from mother palms. Selected seed nuts are sown 5cm apart in sand beds of 1.5m width and convenient length with their stalk ends pointing upwards. Beds are to be watered daily.

Spacing and alignment
Planting is to be done at a spacing of 2.7m x 2.7 m. The rows may be aligned in north-south direction by deflecting the north-south line at an angle of 35° towards west to minimize sun scorching.

Planting
A pit of size of 90 x 90 x 90 cm is preferred when the soils are deep and well drained. In heavy soils with added impedance to drainage, pit size of 60 x 60 x 60 cm is preferable.

Fertilizer application
A fertilizer dose of 100g N, 40g P_20S and 140g K_20 (220g of urea; 200g of rock phosphate and 230 g of muriate potash) per palm per year is recommended along with 12kg of green leaf and 12kg compost or farm yard manure.

Irrigation and drainage
Palms are irrigated once in 7 days during November-December, every 6 days during February and every 4 days during March-May @175 litres of water per day per palm. In drip irrigation, 16-20 litres water per day per palm is sufficient resulting in saving of 44 per cent of water over hose method. Micro tubes / drippers (2-3nos.) should be placed in the basin opposite to each other or in a triangle. Adequate drainage with 75-100 cm deep drainage channels should be provided during rainy season.

Existing Methodologies
Manual harvesting is the traditional method for arecanut harvesting. They use coir loop to hold the tree. There are two types of manual climbing, the front foot and frog-foot type. The front foot technique is very similar to rock climbing. The second method is frog-foot method in which the climber places the legs like a frog on two sides of the trunk. The lack of availability of the labour and labour cost became a severe problem for arecanut tree farmers. To avoid this problem so many climbing devices are developed and are available in the market. Fig 1 shown the manual climbing on arecanut tree. We discuss some manually operated devices/tools in following sections

Fig 1: Manual tree climbing

Fig 2: Tree climbing ladder

Arecanut tree climbing ladder
Arecanut climbing ladder is a simple tool through which only climbing is done up to the harvesting location. As worker reached up to target, another manual harvesting tool is used to impact on the mature arecanut bunch to performing harvesting operation (Fig 2). This is simple aluminium ladder having versatile properties such as light weight, resistance to corrosion and able to withstand cold temperatures. These ladder are designed to climb trees like arecanut, coconut, pepper etc. they are starting from 20, 30 and 40 feet with adjustable features. The stairs which are used to climb are designed in such a way that, it has certain elevation with respect to frame of ladder to support person during climbing. Trained worker climbs a ladder and harvests arecanut bunch with sharped edge tool like sickle.

Tree walker - Standing type tree climber
This is a standing type arecanut tree climber. It is specially designed for the professional climbers. By using steel wire rope, it is possible to adjust with the diameter variation of the tree. So it can be also useful for climbing coconut to palmyra Palm or even Silver Oak & Similar forestry trees. By using hands and legs one can move upward. These types of climbers are highly durable, anti-corrosive and dimensionally accurate. Full body safety is confirmed by additional steel ropes. For these types of products, maintenance is very low. This product can be used only by trained personnel and hence labour and labour cost problems still exist.

Fig 3: Wonder climber

Fig 4: Sitting frame type tree climber

NIF patented tree climber

Joseph M.J. 2006 [4] developed arecanut and coconut tree climber which is one of the successful models existing in the market. It can be used to climb arecanut, coconut and palm can also be used to spray pesticides, harvest fruits and for experiments. It also works as the climbing tool for electricity department. This climber has high demand in South East Asian countries, Indian sub-continent countries, the Middle East Asian countries, African countries, southern Indian states, Oceania countries and Australia. This is safe and easy to use with fine gripping.

Wonder climber

Prakasan T. 2013. Developed manually operated arecanut climbing and harvesting device which consisted of rope and pulley mechanism. The device can be fitted to any arecanut tree with the help of two 'U' clamps. Once it has been fixed, rope may be pulled to get climber up where it is needed. Once it is reaches the desire position, stationary blade impacts on arecanut bunch. Relocation of device also possible. Averagely, 12 to 20 trees per hour can be harvested depending on the height of the trees.

Pedal operated areacnut climber

Sharana Basavaraja J. *et al.* 2015 [7] developed a device for areca tree climbing. The product was constructed to climb the areca tree by applying force on both the pedal alternatively. The product has two units LH and RH, each unit consist of a T-gripper assembly which locks the areca tree, a box –beam assembly which acts as a supporting member of the areca tree climber product, pedal assembly creates the up and down operation of the climbing unit. Initially the climbing unit is fitted at the base of the tree. When the force is applied on the pedal of RH climber unit it creates the grip through the steel wire rope that is connected from T-gripper to the pedal, thus creating the grip to lock the areca tree, The LH climber unit is now pulled up by using the handle that is attached to the T-gripper assembly. The areca tree is climbed to the maximum height by repeating the operation; the reverse operation is followed to descend the areca tree. The result showed that maximum height of 40 feet was climbed. An average of 15-20 trees was harvested/sprayed by climbing the single tree.

Sitting frame type tree climbing machine

Mohankumar A.P. *et al.* 2013 [5] The multi-tree climber is sitting type tree climber mainly used for coconut and arecanut climbing. This climber is operated manually by hands and feet. There are two metallic frames, one upper and one lower used for climbing up and down. Rubber grippers are used to get proper grip between the tree and the frame. It is a low weight sitting model coconut tree climber. This can be used by any person without special training. This device is durable, strong and easy to use. This climber can bear 100 kg weight capacity and can be used both in coconut and arecanut trees.

Advancing technologies in areacnut farming

There is a wide range of scope for expansion of many semi-automatic or automated models for arecanut farming. Such models are driven by either engine or by AC/DC supply. Optimizations of these models are in progress. Researchers are taking keen interest in development of arecanut climbing and harvesting device. Some of the upcoming techniques are quoted in following paragraphs

Tony M. *et al.* 2016 [8]. The device consists of a triangular base frame which supports all the components to be built upon. It is fitted with three DC motors - nylon tyres with rubber grippers at 120 degrees each other for ease of the operations. A specially designed remote controlled spraying unit is mounted on the frame. Power from the battery is supplied to the motors using flexible wires and DPDT (Double Pole Double Throw) switch is used to control the movement of climbing machine as well as spraying unit. DC geared motors having reduction gears which ensures self-locking of the tyres and thus maintains the height. To accommodate for change in the diameter of arecanut tree as the device moves up and down, a spring loaded mechanism is used for exerting sufficient tension required for gripping the tree. The device has been tested for its performance and found safe, reliable, and efficient.

Paul E. *et al.* 2013 designed semi - automatic areca nut tree climbing and harvesting robot. The robot consists of two mechanisms, climbing mechanism and cutting mechanism. The mechanism doesn't require human to climb the tree, but one has to drive it with the help of rope. The power supply for the robot provided from a DC battery or an AC current by using an adapter. It consists of a cutting blade and a climbing mechanism. Ropes are connected in such a way that by pulling the rope from bottom, the mechanism climbs upward. Holders are attached below the blade in order to hold the falling areca nut bunches. The grippers and rollers make the system move upwards and hold the mechanism in position. With the pulling action of the rope, the cutting blade gets

enough power to perform the cutting. An open coil helical spring, also known as a helical spring, is a mechanical device, which is typically used to store energy due to resilience and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces. They are made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded. One type of coil spring is a torsion spring: the material of the spring acts in torsion when the spring is compressed or extended. The quality of spring is judged from the energy it can absorb. The spring which is capable of absorbing the greatest amount of energy for the given stress is the best one. Metal coil springs are made by winding a wire around a shaped former- a cylinder is used to form cylindrical coil springs. The robot is so simple that it can be controlled by anyone.

Fasil T.K. *et al.* 2018 [2] developed remote controlled areacnut plucking machine. It consisted of two rings, two pulleys, rollers, rope, spring, cutter, collector and the main frame. The power from the motor is transmitted by rope pulley mechanism. The machine is placed around the tree and clamped to it by using two rings. Rotation of the motor allows rope to wind and rewind on to the drum. Cutting will happen along the movement of the machine. There is no separate mechanism for cutting to make the system simple. Control over the motor is done by a Bluetooth connected via mobile.

Conclusion

There is a wide range of scope in the development of the many mechanical models and mechatronics model of arecanut tree climbing machines. As Moreover, the latest advancements in the field of robotics and automation can be of a great help to achieve this task of taking the mechanical models to the next level. The drudgery and risk of worker can be reduced by developing such models. If the machine gets breakdown after reaching certain altitude of the tree, then the person travelling in it would have to face consequences. In addition to this risk, there is the need of human effort to make the machine. The mechanical work that needs to be done by a human to ascend the tree via the machine is too much. The advantage that the requirement of a skilled labour who has expertise in climbing arecanut trees and bring arecanut bunch down, falls short when effort of the person travelling is taken into account.

Robotics in the field of agriculture can revolt the existing techniques. It can provide a permanent solution to the long standing issues associated with arecanut tree climbing and harvesting. Problems faced by existing techniques such as weight of machine, machine stability against the gravity etc. can be overcome. By adapting robotics machine/tool can achieve smooth, noiseless and harmless operation also least damage to tree trunk as well as the arecanuts with timeless job and efficient use of power source.

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