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Basin Digging and Fertilization Machine for Coconut Tree

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Abstract: ***The main objective behind project is making the process of basin digging simple and effortless, with help of less manpower and at faster rate. Coconut tree requires a basin which is 3 feet wide and 6 inch deep which is quite tedious task for farmers and time consuming as well. For a farmer having large number of cultivation basins dug wouldn't be uniform and the quantity of fertilizer poured will also vary, indirectly affecting the tree. Our machine eliminates these above drawbacks by digging the basin with required precision and uniformity. We designed our machine with an idea for long term effect in agricultural sector, this machine would be more beneficial for farmers with large cultivation. Basic design of our machine is simple which reduces its fabrication cost, it is very easy to handle. There is no need of skilled operator for this machine. The main purpose of this machine is that it should be affordable to every farmer.***

Keywords: Cost effective, simple mechanism, easy to navigate, small form factor, modular design

I. INTRODUCTION

In the current day and age, horticulture plays a very crucial part in the daily life of farmers in the coastal regions. Horticulture includes vegetables and fruits like tomato, chillies, brinjal, capsicum, pumpkin, cucumber, dates, coconut, peas, cabbage and many more. Out of these, coconut is the most produced fruit. In fact, India is the 3rd largest coconut producer in the world ranking just behind just Indonesia and Philippines totaling of approximately 11,930,000tons annually.

In the map it can be seen that right from the east coast to west coast including a few states from the north east, coconut is vastly produced. Coconuts' remarkable levels of resilience means that they can be grown in a wide variety of soils, although they do require a relatively high amount of rainfall. The natural habitat of coconuts is found in coastal areas and on the fringes of deserts, where it is a primary source of sustenance for dwellers within these climes. The coconut is a tropical tree species, mainly grown and harvested by small-scale farmer.

The coconut is a very useful plant with a wide range of products being sourced from it. Coconut products are used to make everything from clothing to animal feed to beauty creams. Its kernel is harvested for its edible flesh and delicious water, while its husk is used for its strong fibers. Most important, however, are its oils, which are extracted, processed, and marketed for culinary, medicinal, and cosmetic uses alike.

II. PRESENT CONDITIONS

Demand for coconuts has grown upwards of 500% in the last decade. This is because coconut-based derivatives, such as soaps, virgin coconut oil, health products and coconut water, have all seen large spikes in demand, so much so that producers may not be able to keep up. India is requesting international help to streamline their production protocols, and the international community has responded by taking steps to reduce demand for coconuts.

Because demand for coconut is not being met, European markets have taken a number of steps to curb their demand. Specifically, the European Union has proposed levies on vegetable imports to the EU, they have promoted the use of alternative vegetable oils, such as palm, canola and soya, and they have put stricter alfatoxin regulations into place within the copra production market. With the measures being taken to curb runaway demand, suppliers are still making huge amount of money. Fair Trade' practices in the industry try to ensure that the benefits of the booming sector will trickle all of the way down to small farmers, but they unfortunately keep the production rates rising at a slower rate which leads of accumulation of stock. Lack of investment in sustaining the coconut-growing land's productivity, largely due to the high costs associated, mean that some farms are producing 75% less fruit than they did 30 years ago. Even the coconut trees are 50 years old, 20 more than their prime production years, therefore hampering the supply to the increasing demad. According to APCC (the Asian and Pacific Coconut Community), many plantations across Asia are

experiencing zero growth, and some are even ceasing production as their farmers switch their focus to oil palm production. Considering the cultivation techniques, most of the small scale farmers still rely on manual labour to dig and plant the coconut seeds. Modern methods are yet to filter their way down to small scale cultivators. Fertilization techniques also see the same fate in present conditions. Right from digging of the basin to application of fertilisers, everything is mostly done with manual labour.

III. PROJECT SCOPE

Application of fertilizers on a coconut tree is a fairly simple process. It includes digging of a basin of proper dimensions and adding fertilizers in that basin in desired amount. But the procedures used for the fertilization are relatively ancient. Advanced technologies do exist for this application but they find their uses in a very limited scope mainly because of their high initial cost and non-feasible nature. Hence, only the mass cultivators with huge monetary reserves can afford these technologies. Technologies and machines for this purpose include high capacity power tillers, weeders, rotameters etc. The initial cost of these machines from well-known manufacturers is Rs. 40000 upwards. They serve their purposes in singular operation. These machines are difficult to transport and are expensive to run.

On the other hand, manual labour is primarily used to dig the basin as well as apply the fertilizers. Manual labour has its own limitations such as fatigue, non uniformity, fluctuating labour costs, weather conditions. The machine which we are building aims to rectify these quirks and simplify the process of fertilization in the cheapest way possible. We also aim to make our machine modular so that it can be used for various purposes such as fertilizing, weeding, digging basin, etc.

The design of the project is modular, which means it can be modified for other than basin digging activity purposes. The use of parts such as interchangeable blades, variable height adjustment mechanism for wheels and plough help in that process. An anchor point can be used to keep the machine more stable and to fixed on its path while traversing around the coconut tree. The anchor point acts as a stabilization mechanism while also providing accuracy while digging the basin.

But because of the modular nature of the machine, this can be further modified for more diverse applications for example, for the cultivation of sugarcane, the tracks required are wider than previous applications. So the modifications required are, larger wheels with wider section tyres, larger plough with wider angle of throw, and an engine with higher capacity and higher power output.

IV. METHODOLOGY

India's economy is mostly based on agricultural sector and indirectly on Indian farmers. Work of digging a basin around a coconut tree requires lots of efforts or it is done by using using power tillers. But such power tillers are expensive and farmers find it hard to pay for these heavy and expensive machineries. So this new innovation of basin digging machine overcomes this problem. Hence aim of our project is to make basin digging and fertilization machine for coconut tree which is simple to operate, less complex, economic & digs the basin with less effort. The basin digger is developed in such way that it is highly beneficial for farming community, which can compel them to abandon traditional basin digging activities & also overcome the problem of labour shortage and labour cost.

The project starts with

A. Current status of existing power tillers & weedersin market - Considering the cultivation techniques, most of the small scale farmers still rely on manual labour to dig and plant the coconut seeds. Modern methods are yet to filter their way down to small scale cultivators.

B. Analysis of process of basin digging around coconut tree - The process of basin digging around the coconut tree involves digging of a circular shaped pit of an average depth of 4-6 inches. The width can be determined by the requirement of the basin. The rotor blades help in that process. Analysis of process of fertilization of a coconut tree - Coconut palms grow well in a variety of soils as long as it is well draining. They do need an average temp of 72 degrees F. and annual rainfall of 30-50 inches. Fertilization of coconuts is often necessary in the home landscape. The large green leaves of the coconut palm need extra nitrogen.

C. A granular fertilizer with a 2-1-1 ratio should be used that contains both slow-releasing and fast-releasing nitrogen. The quick release will give the palm a fast boost of nitrogen to stimulate growth while the slow release gives gradual nitrogen to the developing roots. There are specific palm fertilizers that can be used or a combination can be applied at the time of transplant. Coconut palms grow well in a variety of soils as long as it is well draining. They do need an average temp of 72 degrees F.

V. CALCULATIONS FOR ENGINE SELECTION

Total load = 17kg

$F = 17 \times 9.81 = 166.77$

rpm = 6500

As per the existing tiller blade models,

R = 11.25mm

Therefore, $T = F \times \frac{D}{2} = 166.77 \times 11.25$

= 1876.16 N.mm

= 1.87 N.m

Engine Selection,

$$T = \frac{hp \times 5250}{rpm}$$

At 5250 rpm, 1 ft.lb = 1 hp

Therefore T = 1.87 × 0.7375 = 1.38 lb.ft

$$1.38 = \frac{hp \times 5250}{6500}$$

hp = 1.70

According to the market survey, the available engines for the specific torque and power requirements were fulfilled by a 2hp, 6500 rpm engine from a Chinese brand named XM. Hence that engine has been selected.

In practice, By trial and error method considering soil resistance, frictional force and normal force, rpm required is 3500

As we know that,

$$T = \frac{hp \times 5250}{rpm}$$

$$T = \frac{2 \times 5250}{3500}$$

T = 2.21 N.m

According to company specifications, the 2 hp engine produced a maximum torque of 2.7 N.m at 6500 rpm. Hence for 17kg load 2hp engine is selected.

VI. FARMERS OPINION

After the testing of the product in the horticulture line of work, the farmers needs were fulfilled. The demand for a reliable machine for the activity of basin digging which will also be instrumental in reduction of manual labour was fulfilled.

The farmers also expressed their needs for a similar machine for digging in sugarcane cultivation applications. Basic modifications like wider section tyres, larger blades will help in the sugarcane applications. We tested the machine in a sugarcane farm but the narrow tyres meant the machine got stuck in the loose soil. Therefore the farmers suggested us to work on the application for the sugarcane farming. Power tiller are much expensive for small cultivators, but this machine eliminates the need for expensive equipment and does the job at a fraction of the price.

Fig. Basin Digging and Fertilization Machine

VII. CONCLUSIONS

A. The rotary tiller was designed to operate on a 2 hp petrol engine and to be operation with the assistance of two ground wheels
B. Weed removing and collecting machine add the modernization in the agricultural field. This machine will make the farmers becomes independent and not rely on the laborers for removing weed
C. Only one person can efficiently operate this weeding machine.
D. It takes a lot less time to till the ground compared to manual tilling.
E. Deeper working depth and a slow travel speed can achieve good weed control.
F. It is portable tiller system which can be driven by manually or automatically.
G. The hassle for separate fertilizer distribution system is eliminated as the machine has its own integrated system.
H. Equal distribution of fertilizers can also be achieved with this method.
I. Statistics suggest that a group of laborers could dig upto 8 basins in a single day but due to this machine, that number might increase.
J. The cost of fuel consumption will be less than the labor costs as it is more feasible to use IC engine than use manual labor for tedious tasks such as digging a basin.
K. The machine is designed to work in all types of weather conditions.
L. The machine is to be fitted with wheels which can be used in any terrain.
M. The machine is very cost effective and cheap to run as compared to the other machines which find applications for similar purposes.

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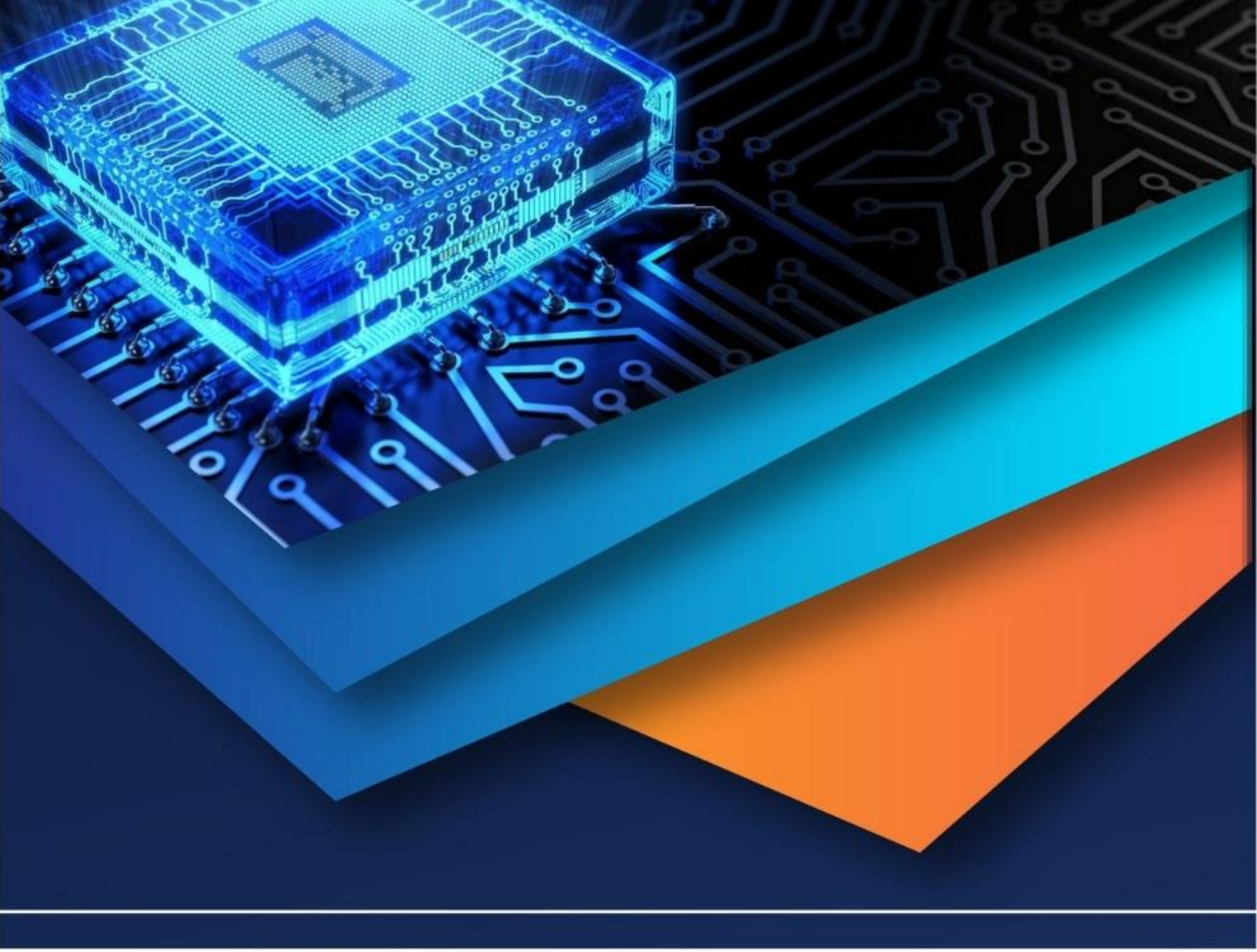

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