

ROOT VEGETABLE HARVESTING MACHINE

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Abstract - Root vegetables like ginger, turmeric, potato etc. are potential agricultural commodity to be developed in India. India is also one of the largest producers & exporters of root vegetables. India is the second largest producer of potatoes in the year 2016 after China and also the ninth largest producer of sweet potatoes. India is also the largest producer and exporter of turmeric with North America being its largest market. India is the leading producer of ginger in the world and during 2012-13. The country produced 7.45 lakhs tonnes of the spice from an area of 165,000 hectares. Root vegetable is cultivated in most of the states in India. However, states namely Karnataka, Orissa, Assam, Meghalaya, Arunachal Pradesh and Gujarat together contribute 65 percent to the country's total production. Root vegetables originated in Asia and now grows in several parts of the world. The root of the plant is harvested for many culinary and medicinal uses. It can be used in many forms and is edible raw as well as cooked. Mainly, the root vegetables are harvested by using hand in India, it is very difficult to harvest crop so we decide to make harvesting machine which should be economical. The farmers complain for the need of so many work forces for harvesting while the labor cost is getting increased and the time spent for harvesting process is too long. Although there is an alternative of imported harvesting machines, they are not compatible with the farming environment in India, having a high initial and maintenance cost. By this machine, the farmers will be able to harvest an entire field having the area of 1 acre with 3-4 hours, instead of taking 1-2 days by harvesting the same manually.

Key Words: Root Vegetables, harvesting, cost-effective, faster operation, digger, screener and Power Transmission System

1. INTRODUCTION

Root vegetable is a potential agricultural commodity to be developed in India and India is also one of the largest producers & exporters of root vegetables. India is the second largest producer of potatoes in the year 2016 after China and also the ninth largest producer of sweet potatoes. India is also the largest producer and exporter of turmeric with north America being its largest market. India is the leading producer of ginger in the world and during 2012-13. The country produced 7.45 lakhs tonnes of the spice from an area of 165,000 hectares.

Traditionally root vegetable plant is harvested manually to get the root vegetable out of ground. But it consumes more time and more physical exertion of worker. It is necessary to introduce machine to harvest to reduce time consumption and human efforts. A machine of this nature can be fabricated at village level application in India such as to harvest at minimum time and a minimum cost, to get root vegetable as quickly as possible from the field, to reduce the physical exertion, to avoid physical damage to the root vegetable, to reduce man power and to ensure the safety to labors.

1.1 AIM AND OBJECTIVES

This project is focusing on design and fabrication root vegetable harvesting machine. This machine can be used in any farming condition in India and can be prepared at village level. This machine has three main parts namely, root vegetable digger, screener and power transmission system. The screener will not only separate root vegetable from soil but also not let the root vegetable get harmed. The screener also uses for collectible part, to make this machine need some power transmission system from the engine.

This machine needs a 2 stroke petrol fuel chainsaw engine with rotation speed 9000 rpm approximately with the aid of chainsaw accelerator lock.

Smaller and efficient combine harvesting which would be more accessible and also considerably cheaper. The mission is to create a portable, user-friendly and low cost mini harvesting machine. The idea was to create a machine which is cheap and will reduce the labour required to harvest root vegetable.

Maximum average force to dig out the ginger from the bed,
 $F = 42 \text{ kg}$

$$\text{TORQUE} = \text{FORCE} * \text{DISPLACEMENT}$$

$$V = 3.14 * d * N1 * (1 - 0.02) / 60$$

where v is the belt speed

N1 - Initial speed of engine

d - Standard size

Root vegetable was harvested by using hand, it is very difficult to harvest crop so we decide to make harvesting machine which should be economical. Most of the Indian farmer's economic condition is not good, so they not able to buy tractor or large harvesting machines, so this kind of equipment's help them to harvest in low investment.

Root vegetable is one of the spices that support large number of farmers in the states of Kerala, Karnataka, Arunachal Pradesh, Orissa, West Bengal, Sikkim and Madhya Pradesh. However, Karnataka, Orissa, Assam, Meghalaya, Arunachal Pradesh and Gujarat together contribute 65 percent of the country's total production

It has been used as a spice and medicine in India and China since ancient times. It was the first oriental spice known in Europe and having been obtained by the Greeks and Romans from Arab traders, who kept a secret of their origin of the spice in India. In India, it is grown in the states like Kerala, North States, Sikkim, Himachal Pradesh, Odisha, West Bengal, Karnataka, Andhra Pradesh and Maharashtra.

$$\text{Power delivered} = (T1 - T2)v/100$$

Where,

T1 = Tension on tight side(N)

T2 = Tension on slack side(N)

$$\sqrt{T1} + \sqrt{T2} = 2\sqrt{T0}$$

Where T0 = initial tension(N)

1.2 Components of RVHM

The main components used for the working of RVHM are

- Chassis
- Engine
- Belt drive
- Shaft & Bearing
- Blades
- Fastner
- Fuel tank

2. DESIGN AND FABRICATION

The ultimate aim of the machine is to harvest root vegetables without any left overs underneath and make the process easy. The initial design consists of a six legged structure, with a basement and wheels attached to each leg. At the one side of the chassis, there is a 2 stroke chainsaw engine is mounted and is powered by petrol fuel. Start the supply of fuel to the engine and the engine is started by cranking.

Table -1: Manual Method & Root Vegetable Harvesting Method

| Manual Method | Root Vegetable Harvesting Machine |
|---|---|
| During harvesting 20% waste occurs that means some part of the root vegetable remains in the soil | During harvesting 5% waste occur that means we can completely pullout the root vegetable without any damage |
| More time consuming process | Less time consuming |
| High man power required | Less man power required |
| High labour cost required , skilled labours required | Less labour cost, i.e. using this machine only few labours are required for harvesting large areas and it requires no specific skills |

The top view of RVHM shows Belt drive, Blades at the two ends, Engine, shaft & Bearing etc.

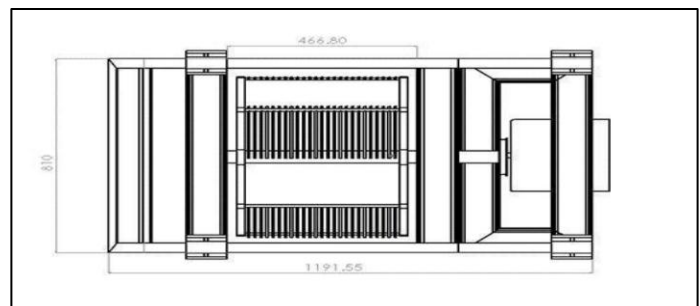


Fig -1 : Top view of RVHM

2 Design and fabrication

An accelerator lock is provided for locking the engine at a rated speed or RPM. On the other side of the chassis, a solid shaft having a number of blades over the shaft is mounted by using two ball bearings. One end of the shaft is fitted with V pulley, which is connected by using appropriate V belt to the engine output pulley.

The driven shaft get slow speed by using chainsaw accelerator lock. By rotating the drive shaft, the blades penetrates the soil of the root vegetable bed. The soil is loosened by the blades and the blades pulled out the root vegetable from the bed. As per alignment position of the shaft the harvested root vegetable is throw out on the sides of the moving machine. Fiber castor wheels.



Fig - 2 : RVHM isometric view

Measuring and marking the C-channel made of mild steel as per the design by using measuring tape. Using power hacksaw cutting the material for manufacturing the chassis. 2 pieces of 1000 mm length of 4 inch standard size for the foundation. 4 pieces of 900 mm length and 2 pieces of 700 mm length are cut for the pillars. 5 pieces of 800 mm length are cut for connecting the pillars. Joining the cut pieces of channel by using MIG welding as per the design. 300 mm diameter round MS shaft is cut for 850 mm length. On lathe the shaft is cut for step of 20 mm diameter on two ends for 15 mm length. Blades are

The blades are fixed over the shaft by welding as per the design. The pulley which is purchased of 10 inch diameter is fixed on one end of the drive shaft. Already purchased fibre castor wheels are mounted on the chassis by using nuts and bolts. The 2 stroke petrol fuel chainsaw engine and its accessories are mounted on the chassis as per the design by using nuts and bolts. Also provide rectangular slots for adjusting the engine position. Then suitable V belt of appropriate length is provided for the power transmission from the engine shaft to driven shaft.

3. CONCLUSIONS

The idea was to create a machine which is cheap and will reduce the labour required to harvest crops. This machine has the capability and the economic value for fulfilling the needs of farmers having small land holdings. Comparisons are made between manual and machine harvesting. At present day ginger is harvested manually with the aid of labor, they demand Rs 100 per 60 kg of ginger. The performance of the harvester is evaluated in the field. The cost of the machine is about Rs. 26,000/- and if the farmer buys this machine, he or she can recover the invested money back by harvesting two and half acres

It is quite simple in design and fabrication, so it can be fabricated at village level. By adapting this machine, problems of the labour crises can be reduced, when compared to manual harvesting with only 18% of labours being required. It makes the process faster than manual harvesting and hence reduces most of the harvesting time and labours required to operate the machine; thereby, it reduces the labour cost. The machine can be used by a maximum number of farmers; definitely farmer can overcome the labour crisis problem. The productivity can also be increased.

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