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ijirset@gmail.com

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Root Vegetable Harvester

Karan Jadhav¹, Yogesh Pawar², Nitin Gadakh³, Rushikesh Joshi⁴, Prof. A.R. Devshette⁵

U.G. Student, Department of Mechanical Engineering, Rajashri Shahu College of Engineering, Tathawade,
Pune, Maharashtra, India

Associate Professor, Department of Mechanical Engineering, Rajashri Shahu College of Engineering, Tathawade,
Pune, Maharashtra, India

ABSTRACT: This paper introduces a personal assist device to harvest root vegetables such as radishes which are a representative crop planted by many farmers in Japan. Specifically, our research work tries to solve problems by developing a novel assist device that is compact, inexpensive, and easy to handle by anyone, and that can reduce the burden on users. As a solution approach, two mechanisms embedded in the proposed assist device are designed and developed: 1) grasping mechanism for grabbing crops and 2) digging mechanism for raising crops buried in the ground. The design of this harvesting assist device based on these mechanisms and its features are explained in detail in our paper. The effectiveness of the assist device was verified through extensive experiments in a farm field. To enhance the feasibility and efficiency of the harvesting device, our future work includes the study direction of stable grasping for different sizes and shapes according to crops.

I. INTRODUCTION

Onion harvesting is one of the most important operations has to be performed preciously to have a good Onion production. It has a direct effect on the Onion bruising. Bruising has an essential effect on Onion marketing. The mechanical brushing could be happened when the tractors wheels roll on the Onion rows during harvesting. Solanum Tuberosum L., Onion derived from Spanish language “Patata” is an ancient cultivated crop of South America of 16th century when Spaniard arrived and has been considered as one of the oldest tuber crop brought under cultivation in all countries of the world. According to Hawke’s, Onion plant was taken to India by the British missionaries in the late 17th century and to China, a little earlier. Since then, Onion is cultivated through the country as a vegetable crop. In India, Onion is known by various names in different regions and in various languages, such as Alu in Bengali, Onion in English, Aloo Batala in Gujarati, Aalu in Hindi, Urala Kizangu in Malayalam, Bilati Alu in Oria, Uruzhai Kilangu in Tamil, Bangaladumpa Aalugadda in Telugu etc. Onion is considered as one of the most important vegetables crops, supplying human with carbohydrate. It is classified as the first alternative of the grain crops to solve the shortage of food in some countries. Onion, an ancient crop of 16th century was found in South America when Spaniards arrived in the 16th century. Further many more wild species occurred in South America and more specifically in the Andes of Peru and Bolivia, from one or more of which cultivated Onion could have been derived. From the Spanish introduction, it was then spreader to the continental Europe and Asia. It was then spreaded to Ireland, Scotland, Wales and parts of Northern Europe and from one or more of the British sources to most of British overseas colonies, including what was later taken to U. S. A. from Scotland, the Onion was said to have been taken to Italy, from where the samples were sent to botanists in many parts of Germany and Australia. In the mid-eighteenth century the Onion from Scotland and possibly been taken to Norway then to Sweden and Denmark. According to Hawke Onion plants have been taken to the India by the British missionaries in the late seventeenth century and then to China, a little earlier. It was grown in Japan by the late seventeenth century and in part of Africa and West Indies around the same period.

Onion harvesters are machines that harvest Onion. They work by lifting the Onion from the bed using a share. Soil and crop are transferred onto a series of webs where the loose soil is sieved out. The Onion are moved towards the back of the digger.

Field operations cause most damage to Onion when they are dug in dry, cloddy conditions. The clods rub against the Onion and force them to the outer edges of the primary conveyor where mechanical damage occurs. Vibratory and rotary tillage tools develop smaller soil clods. This reduction in the size of soil Clods during the digging process can help to minimize damage to the Onion, facilitate lifting the Onion from the digging blade.

In vibratory tillage, the formation and nature of soil fractures and their sizes depend on the forward speed and the basic parameters of vibration, Vibratory frequencies and amplitudes over a wide range have been reported as optimum. The optimum design parameters of vibratory diggers are apparently also dependent on tool geometry, soil type and condition, digging depth and direction of vibration.



II. LITERATURE REVIEW

P.Azizi et al (1): Design and Construction of Onion digger machine with rotary blade. In this study, a new semi-mounted one-row Onion digger with rotary blade was designed and made in the workshop of Shahrekord University. It can be connected to rotary Onion graders. Transmission system was mechanical from tractor (PTO) to blade by belt, pulley, gearbox, chain and sprocket. Blade diameter was 76 cm and the length was 10 cm which was assigned by the researchers. For separating of soil from Onion, a helix containing bars with 2.6 cm distance and diameter of 9 mm was applied. Entered soil into set was calculated as 227 ton/h. Required power was got 5.5 horsepower. Computerized model of set was prepared in Mechanical Desktop Software and Onion motion was studied in Visual Nastran Software. The device was tested at field with various advance speed, blade angle and rotational speed. Results showed that advance speed of 1.5-3 km/h, rotational speed of 20-25 RPM and blade angle of 10- 15° were proper for system. The average of damaged Onion was 4%.

M.E. Wright et al (2): Vibratory for harvesting sweet Onion in cloddy soils. In this study, A vibratory digger blade for proposed use on a sweet Onion harvester was designed and tested. Investigations were conducted to evaluate the effect of peak acceleration of vibration and the combined effect of three operating variables (forward velocity, amplitude and frequency of vibration) on the geometric mean diameter (g.m.d.) of clod size and on percent reduction in soil bulk density after treatment. A dimensionless velocity ratio was formed to express the combined effect of the operating variables. A mechanical rotary soil sieve was built and used for separation and measurement of the clod sizes. Vibratory and non-vibratory operations of the digger blade were compared. Low and high-density soil conditions in a silt loam soil (1.16 g/cm³ and 1.28 g/cm³) and two levels of each of the operating variables were tested. It was found that the vibratory digger, as compared with the non-vibratory one, produced smaller soil clods and a greater reduction in the soil bulk density. Peak acceleration values greater than 3 g produced approximately the same clod break-up and reduction in soil bulk density. Peak accelerations below 1 g resulted in poorer clod break-up. Dimensionless velocity ratios greater than 3 improved the performance of the vibratory digger blade.

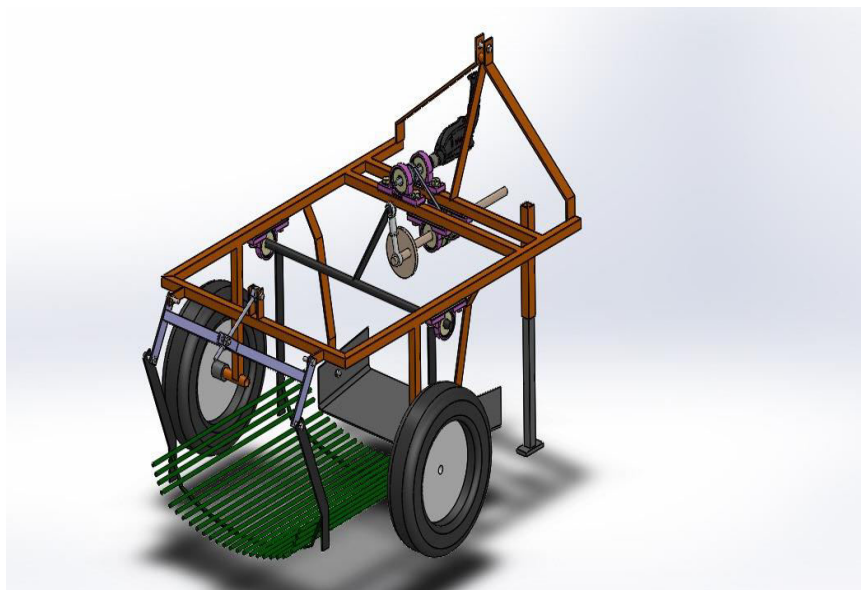
S. Karthik Subramanian et al (3): Design and Fabrication of Underground Vegetable Harvester. This study aims to harvest underground vegetables such as Onion, onions and carrots in an efficient manner. This harvester was fabricated to facilitate effective harvesting and to reduce manual efforts of harvesting underground vegetables by farmers in the field. This objective was accomplished by a setup consists of a set of jaws, a conveyor setup and a collection box. These were connected by a set of gears actuated by chain drives. The project was done after conducting studies on various approaches towards vegetable harvesting. Crop parameters and field parameters were considered. The distances between placements of successive crops were considered. The experiment was done to get an insight of both qualitative and quantitative aspects of the field as well as the various reactions to impacts during harvesting. A few areas regarding scope for future improvements were discussed and suggestions were made.

III. METHODOLOGY

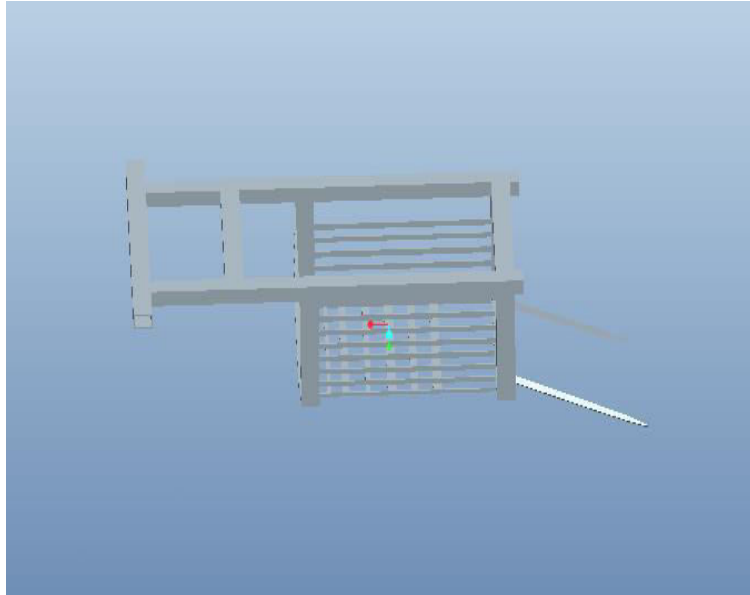
From the flow chart, this project started with the objective of the project. The objective of the project must follow the title. The objective must fulfill the title Then follow up with design review about folding table and then study a lot of investigation about folding table. This is including study about several of stage, type of stage, types of material which suitable to make a stage. These tasks have been done through study on internet, books and others resources. After all information had been collected and gathered, the project continued with the design process. All the knowledge and lessons had been applied to make a suitable design for the project. After several design sketched, design consideration have been made and one of the design have been chosen by using Pugh's concept selection. The solid modeling and engineering drawing by using solid works software the fabrication process progress use drawing as a reference. The process consist fabrication to all parts that have been designed by the dimension using various type of manufacturing process. The manufacturing process includes welding, drilling, bending, cutting and etc. During the fabrication process, if there have error occur, such as fabrication error, so the process need to modification the process need to go back to the previous step and the process flow again, until no error occur the process can be continued smoothly until the final product finished. Then, the draft report need to be submitted to the supervisor for double checking if there had an error.

3.1 Constrcution

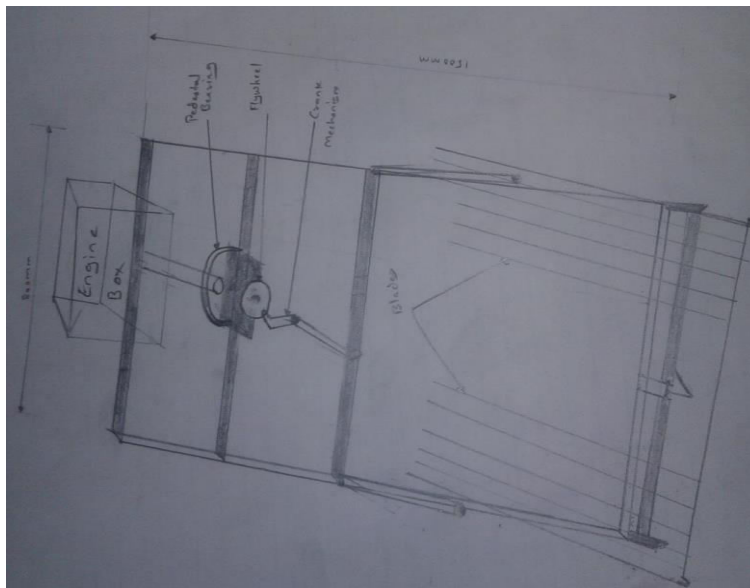
- The vibratory digger blade assembly consisted of a steel plate and its associated framework and drive mechanism. The blade does the actual soil cutting. It is attached to the bottom or horizontal plate at an angle of 20 degrees and its oscillated front and back. Its function is to break up clods and aid in feeding soil and Onion onto the primary conveyor of a Onion harvester. The plate is 10mm thick 300 mm wide and 200 mm long.
- The digger blade assembly is mounted on a 7 kW SI engine. at a constant speed of 312 rev/min. At this p.t.o. speed, the vibrating plate was vibrated at a frequency of 15 Hz.



Model:



2D Model:



3.2 Onion digger

Onion is the major crop grown in country. It is a rich source of carbohydrate, used all over the country. Onion is harvested when it attains the physiologic maturity. Onion harvesting is time consuming operation due to its various activity taken place at the same time. There is different equipment of harvesting the Onion from the field. This equipment is tractor operated, animal drawn, or hand operated. Tractor operated Onion digger cum elevator is mainly used for digging and exposing Onion tubers simultaneously. The digger was found to perform very well under varying soil condition. A Onion digger cum elevators was designed and constructed which is capable of digging Onion with a minimum of injury working on the principle of digging and elevating the soil and Onion simultaneously. It reduces 75% labour and 50% operating time compared to conventional method of manual digging with spades, kudali and khurpi. It also results in 4-5% reduction in harvesting losses.



Fig. Onion digger

3.3 PRE-DEVELOPMENT OF FARM

Hand digging is said to cause mechanical damages to about 40% of tubers and it is estimated that up to 20% of the crop is left underground. It is estimated that almost 100% of tubers can be harvested if appropriate tools are used. So the aim here is to built the Onion digger which will get the power by Tractor (here in this project we are using gear motor). The mechanism should be simple, cheaper, light weight possible and possible good in function.



IV. CONCLUSION

Onion is vegetable crop of both sub-tropical and temperature region of the country. It occupies the largest area under any single vegetable crop in world and produces more food content per unit area than cereals in short span of time. Onion harvesting is time consuming operation due to its various activity taken place at the same time. The harvesting, collection, bagging and transportation to the cold storage / stores operations are done simultaneously. Traditionally

Onion is harvested with Khurpi / spade/ kudali and is considered to be labor intensive and time – consuming process. These operations require about 210 man-day per hectare when the crop is harvested manually with spade, khurpi or kudali. The field also become undulated when Onion is harvested manually, and require 2-3 ploughing for next crop. The cost of production of Onion become very high because of labor charges and also harvesting. It requires more energy (600 man-ha/hr) than with animal drawn Onion digger (400-425 man-ha/hr). On the contrary mechanical harvesters like spinner digger, elevator digger is the labor saving devices but at same time causes increased tuber damage and losses. Commercially available tractor mounted Onion digger cum elevator are common with farmers having 10 ha or more land. Onion damages like bruise, cut, split etc. are of the order 10-12 per cent in elevator diggers. Two pairs of elliptical sprockets that cause separation of Onion from the soil, soil clods and foreign material, if any are responsible for damage. Therefore, it was felt essential to estimate the extent and type of damage, and soil-Onion separation by the Onion elevator digger. A Onion digger cum elevator was designed and constructed which is capable of diggings Onion with a minimum injury, working on the principle of digging and elevating the soil and Onion simultaneously. The digger, which is equipped with hydraulic drive, was found to be very flexible and could accommodate variable condition. Tractor drawn Onion digger elevator is suitable for digging and exposing tubers. It saves 75 percent labor and operating time and 50 percent cost of operation compared to conventional method of manual digging with spades or by cultivators. It also resulted in 4-5 % reduction in harvesting losses.

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