

DESIGN AND DEVELOPMENT OF WEED REMOVING OF GROUNDNUT PLANT

¹Srinivasa, ²Dr. B. S. Dayananda, ³Dr. A. C. Lokesh

¹Ph.D. Scholar, ²Associate Professor, ³Professor

Faculty of Art and Design

M.S. Ramaiah University of Applied Sciences, Bangaluru, India

Abstract:

Weed is a main problem in crop production, affecting the crop yield as well as the quality of crop produce. Majority of the farmers followed traditionally method of removing the weeds. However, advancements in technology present an opportunity to develop machinery that can streamline and enhance the process. And many farmers are using chemical methods are using to remove the weeds. These methods are dangerous for the atmosphere as well as even human health. Sustainable development of agriculture, it is critically important to develop chemical and pollution-free agricultural products. To meet this demand, a new groundnut harvesting product has been designed, taking into consideration various parameters such as customer needs, product size, mechanism type, ergonomics, spare parts availability in rural areas, and field performance. To identify the specific requirements for groundnut production, a comprehensive study was conducted, involving interviews with approximately 300 farmers. Statistical analysis and experimental data were used to make assumptions, Likert scale is used to evaluate the facilities, like labor availability, machinery and wages paid during cultivation season is analyzed. And also prepared the Product Design Specification (PDS) for develop the product. Based on these findings, three concepts were generated and created in 3D virtual models. The final concept was selected using the PUGH matrix method, and the resulting product consists of a wheelbase, engine, belt and chain drives, and handles are the important parts to develop the new concept. Finally, physical model was made to prove in the filed.

Keywords: Weed remover, Groundnut field weed removing, weed remover m/c, Weed Management, Weed control, Mechanized method weed removing.

Introduction

Weed removing is one of the major problem in the agricultural field. In India farmers are still using manual method to remove the weeds for many crops. Many machines are available in the market but not suitable for marginal and small farmers. In India majority of the farmers are belong to small and medium farmers. Currently for weed removing Soil tiller and tractors are available but not suitable for many crops like paddy, tomato, Brinjal, sugarcane soya bin crops. The main aim is to internal cleaning of crops. In manual method is very hard to remove the weeds and cultivation cost high and need more labor to complete the work. Even conventional method farmers are using bullock for weed removing, even cultivation cost is increasing day by day, and even bullock cost also increasing, so that small farmers are not affordable, and labor scarcity is increasing in the villages. The main objective is to reduce the manpower and increase the profit margin for small land holders and reduces the working time. Most of the farmers have limited land as a result, they are not capable to purchase the expensive machineries. Inside the crops cleaning is difficult the such as tomatoes, sugar cane, soy crops and vegetable. which are grown by small and marginal farmers. The tiller and tractor are replacing the labor force and animal power and at the same time supporting to farmers.

Literature review

In India more people depends on agricultural, more jobs created in agricultural sector. Even in the agricultural man power is need for many work compared to other fields. Like ploughing, seed plantation, harvesting. In case of weed removing very tedious job in agricultural field and need more manpower needed. Weed removal machines were develop the low cost with distance between the two rows are adjustable according to their requirements and even blade distance based on plant distance. For this machine diesel engine is used. For remove the weeds rotary blade are connected and the blades are connected to shaft and shaft connected to engine. The handles are provided to turn the machine and blades are rotated in clockwise direction and remove the weeds [1]. In this direction developed automated weed removing using image processing technique, In the present situation farmers are spraying herbicides to remove the weeds and get the good result in initial stages and later causes the land infertile and there by cause the reduce the production [2]. The product developed for detect the weed with vision system and differentiate the weed from the crop. For tracking the rows the guidance system is used with accuracy. The mechanical methods to removing the weeds from field. The knife is attached to remove the inter rows weeds. This system is helpful to avoid the herbicides in the field [3]. Mechanical methods are used to remove the weeds automatically with help of microcontroller, from the seed line. The mechanical rotary and torsion weeder remove the weeds. This design avoid the consumption of herbicides in the agricultural field [4]. 3Dimage processing systems were used to locate the weeds and safeguard the plant point cloud featuring and using Zed technology [5]. Movement of the tool responsible for eradication is proposed. This article presents the solution for finding weeds within a crop field using classifiers and the integration of a 3D-vision system that builds a point cloud featuring the plants to safeguard, the weeds and the free space using Zed technology. In the agricultural field weed managing is very challenging in the small and marginal land holder due to non-availability of labor in the current days and also labor cost is increasing day by

day. Provide the detailed information about weed management with herbicides and safe use to avoid the adverse effect on human health [6]. In the organic farming is followed traditional method, even today also research is going on management the weeds without chemical. In the organic farming not eliminated the weeds instead of managing like crop rotation, grow the competitive crops, Intercropping method, cover the crops, mulching, Mechanical weed management, tillage and Pneumatic weed control. All these methods followed from the history and improve the yield [7]. India is spending lot of of money for removing weeds, about 33% of loss from economy form weeds. For many reason to losses like crops diseases, insects, rats and labour shortage due to decreases the income. He designed the mechanical weeder , he developed two types of weed remover like primary cutting edge loose the soil and secondary cutting edge lifting the weeds. And designed additional attachment for funnel type circular ipe for fertilizing and seeding also. This concept is suitable for small land holders. The disadvantage is single wheel weeder difficult the move some times, but blades are very thin and tough and less maintenance [8]. Farmers are trying many methods to remove the weeds in the dry land such as sickle and animal driven method of traditional method of removing the weeds. Another method of removing the weeds by chemical method and also lessening the soil quality. And some few crops burn the weeds directly on field. Flame destroyers about 3500⁰F but this method is very expensive and difficult to plant from flame. [9]

Material and methods

Study Area : The data was collected from Chitradurga and Tumkur districts of India, which is located in the central dryzone of Karnataka. This is located between 76° 34'49.86"E to 76° 51' 32.13"E and 14° 14'13.63"N to 14° 30'28.30" The temperature in these areas varies from 17°C to 43°C depending on the seasons. The rain fall ranges between 453.5 and 717.7 mm and found to be maximum during Kharif season. The soil is sandy loam and red in major areas and remaining areas are deep black. The main crops grown in these areas are Groundnut, Ragi, Jowar and vegetables.

Ethnography study:

Based on government guidelines, the collected research data has been categorized into five groups: marginal, small, semi-medium, medium, and large farmers. A sample size of approximately 300 farmers was collected, and the results revealed that the majority of farmers were classified as marginal or small farmers. It was observed that in the central dry zone of Karnataka, over 90% of farmers still rely on traditional methods of weed removing and harvesting for groundnuts production.



Figure 1.1 Weed removing Method

Above figure 1.1 shows that 20 to 30% of the farmers preparing mechanized method of weed removing. Due to labour problem in rural area. Small and marginal farmers are depend on labor and animal drawn equipment for weed removing. Large land holders are preparing mechanized method of weed removing.

Product Design Specification for weed removing

Power requirement for product

Horsepower is a critical factor for any agricultural machinery and equipment. When horsepower is too low, slippage, overloading and an inability to complete the work within the set timeframe can occur, leading to increased operational costs. Horsepower depends on the type of land and the operations being performed, and can vary drastically according to soil conditions, moisture levels, and the gradient of the land. Most tractors, tillers and other equipment are rated according to their maximum observed Power Take Off (PTO) power. However, due to slippage, overload and other factors, the PTO power can drop to 10-15%, while the Draw Bar Horse Power (DBHP) can drop to as low as 62.5% on firm soil, 55% on tilled soil, and 47.5% on loose soil (as reported by Robert G. White) [10],[11].

Power equipment for weed removing from groundnut plant

Farmers are straggling to remove the weeds in the agricultural area, because weeds are grooving varying depth, like 2 inch to 4 inches. Sometimes even more than the specified depth. while designing consider the average depth for calculation .

Distance between plants 10 to 11 inch (25cm to 27.5 cm)

Depth of weed removed from ground (5cm to 10 cm) (3 to 4 inch)for calculation 7.6 cm (3 inch)

Draft requirement (D)

$D = \text{Area} * \text{Unit draft}$

$= \text{Depth} * \text{Width} * \text{No. of bottom(attachment)} * \text{Unit draft moist soil}$

No. of rows remove the weed = 3 (three rows attachment)

$$D = (7.6 \text{ cm} * 70 \text{ cm} * 3 \text{ bottom}) * 0.352 \text{ kg/cm}^2$$

$$D = 1596 \text{ cm}^2 * 0.352 \text{ kg/cm}^2$$

$$D = 561.7 \text{ kg} * 0.00981 / \text{kg} \text{ (convert kg to kN)}$$

$$D = 5.51 \text{ kN}$$

Drawbar horsepower

$$\text{DHP} = \text{speed} * \text{draft requirement} / \text{constant} \quad (c=3.6 \text{ for metric system})$$

$$= (3.48 \text{ km/hr.} * 5.51 \text{ kN}) / 3.6$$

$$= 5.32 \text{ kW}$$

$$= (1 \text{ kW} = 1.34 \text{ mechanical horse power})$$

$$= 5.32 * 1.34 = \mathbf{7.13 \text{ hp.}}$$

We can conclude that horse power requirement for weed removing three rows is 7.13 HP

Product Design Specification for Weed removing

The PDS is a specialized tool designed to remove weeds from the groundnut plant. It features a unique digging mechanism that allows the user to dig deep into the soil and extract various types of weeds, ranging from those that grow up to 2" to 3" in height, to those that grow 2" to 3" beneath the soil surface. To ensure complete removal of the weeds, the machine is equipped with harrow-type blades or rotating types of blades. Additionally, this equipment is able to remove up to 3 rows of weeds simultaneously.

Table 1.1 Product Design Specification for Weed removing

Sl No.	Parameter	Factors	Specifications
1		Product Name	Automated groundnut production system
2		Area of use	Indian Village
3		Target customer	Small and medium land farmers
4	Geometry	Maximum Size	1200 x 600 x 900 mm (LBH)
		Weight	60 Kg with attachment
		Distance between the wheel	558.8 mm
		Wheel size	Wheel Diameter: 400mm
5	Serviceability	Life span	10 Years
		Maintenance	Every 200 Hrs. of usage and Oil changing , cleaning and assembly fittings
		Quality	Durable, low cost maintenance
6	Usability	Ergonomics	Design with reachable controls and Accessibility
		Features	Main Base and Weed removal attachment
7	Safety	The product must be safe for the operator	Design with no sharp edges and considering Low accident risk for the operator
8	Technical Specification	Motor Specifications	9 HP , 4-Stroke Air-Cooled, single cylinder
		Power	3600 RPM
		Displacement:	198cc

		Fuel type	Petrol
		Fuel Tank capacity	3.5 Litres
		Type of mechanism	Belt drive or chain drive
		Distance between rows	279.4mm
		Number of rows remove the weeds	Three rows simultaneously
9	Manufacturing Method	Manufacturing of product	Metal Components , Fabrication, standard parts (Machining process, sheet metal stampings)
			Plastic Components, (Injection Mould)
10	Materials	Materials used	Structural frame , MS Angle. Attachment part sheet metal Handle : Steel
11	Efficiency	Capacity	one to two hectare per day
12	Cost	The device is economical	INR 20 ,000 to 30,000/-
13	Standard parts	Available in Local Area	Fixing components like nut and bolts, washer , diesel motor and Inserts replace very quickly,

Concept of Base Product: After conducting a detailed survey, generated innovative concepts to effectively remove the weed from ground. Developing the walking tiller that combination of belt and chain drives with an engine, wheels, and handle. This product is illustrated in Figure 1.2, Designed main base product and various attachments can attach and also remove the weeds from the groundnut plants.

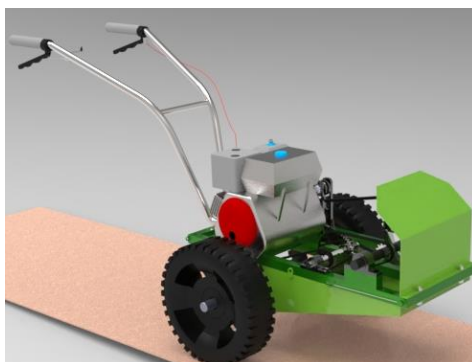


Figure 1.2 Main base walking tiller

Concept-1 weed removing method in groundnut plant

Weed or herbicide control is an essential part of agricultural operations. To effectively manage weeds, many chemical and mechanical methods have been used, such as removal of weeds permanently or cutting them down without damaging the crops. To make this job easier, many tools and equipment are available in the market. To address the needs of users, three new concepts have been developed, which are significantly different from those currently available in the market. One of these concepts is for groundnut plants and is shown

below. It consists of a new attachment connected to a walking tiller, which is supported by a two-wheeled trolley. The attachment has two parts: a major body and an insert. These concepts cover three rows at a time, and three places are provided in the attachment to fix the insert. The insert is made of a “C” section of hardened material, and it is secured with bolts and nuts. This design is intended to make the task of weed removal more efficient.

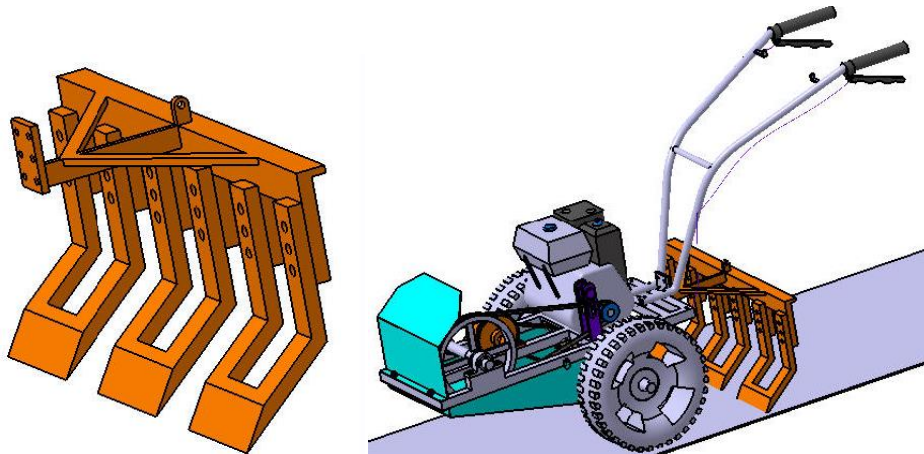


Figure 1.3 Concept-1 Weed removal attachment

Concept-2 Weed removing method in groundnut plant

Concept 2 is an innovative design for weed removal in groundnut fields. Unlike Concept 1, this design features an attachment connected to a main tiller with two main parts: a major body and a rotating roller. For assembly, a shaft is used to attach the two parts. The attachment covers three rows at a time, with three cylindrical rollers, each with six blades arranged at an angle of 60 degrees. These blades are designed with the groundnut plant rows in mind, taking into account their distance and depth. With the walking tiller in motion, the attachment will remove weeds and cover 2-3 acres of land in a single day. This system reduces manual labor and time consumption significantly compared to the traditional manual method.

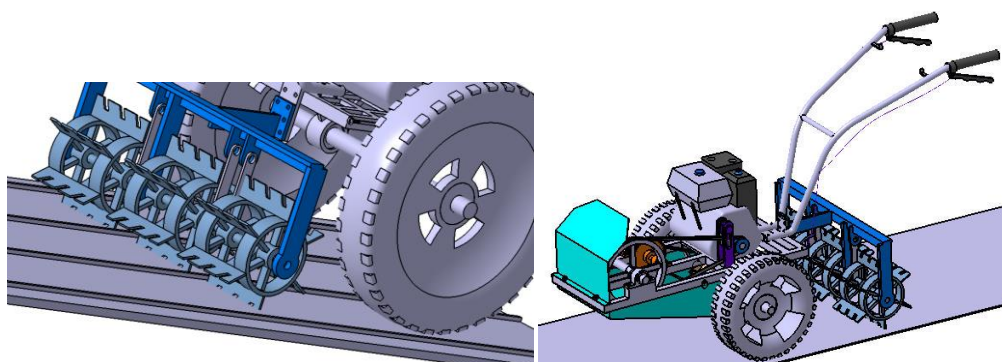


Figure 1.4 Concept-2 Weed removing attachment

Concept-3 Weed removing method from groundnut plant

Concept 3 is a revolutionary design for weed removal in groundnut fields, offering a solution different from Concepts 1 and 2. The attachment is connected to the main tiller, comprising two main parts - the major body and the insert. This concept covers three rows at a time, with three inserts: two in the front row, and one connected behind between two rows, as shown in the figure. The inserts plough the ground to a depth of 2-3 inches, removing the weeds. Easy to assemble, the inserts are held together with bolts and nuts. This system is efficient and cost-effective - capable of covering 2-3 acres of land in a day, and reducing time consumption when compared to manual methods.

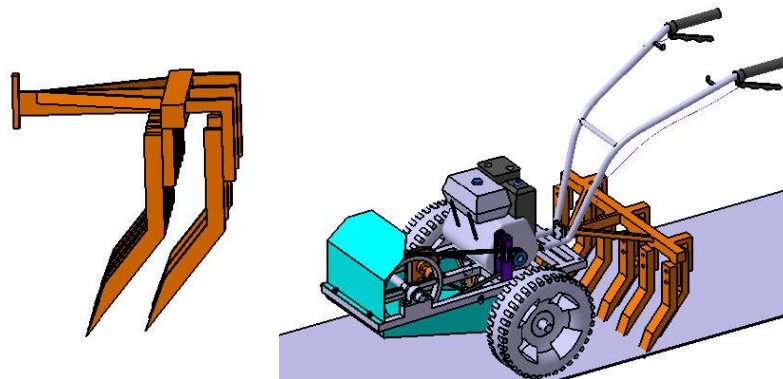

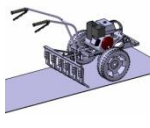
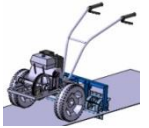
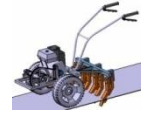


Figure 1.5 Concept-3 Weed removal attachment

Final concept Selection in weed removal method in groundnut plant

The Pough Matrix is powerful concepts for selection that can help organizations make the best decisions. It is an analytical tool that can help you compare and evaluate choices based on four criteria: cost, functionality, risk, and customer satisfaction.

Table 1.2 Concept selection of weed remover
(Kisankraft KK-IC-410P Petrol Power Weeder 270cc, 9HP)

Criteria	Datum 	Concept-1 	Concept-2 	Concept-3 
		Compact	0	0
Less maintenance	0	+1	+1	+1
Easy assembly and disassembly	0	+1	-1	+1
Cost of Product	0	+1	+1	+1
Safety in use	0	0	0	0
Comfortable to operate	0	+1	0	+1
Availability of spare parts	0	+1	+1	+1
Efficiency	0	+1	0	0
Total Score		6	2	5
Rank		I		II

Concept 1 is selected based on above parameter compare to datum product, this is concept is fulfill the requirement and very efficient and low cost compare to other products.

Final concept selected for weed remover

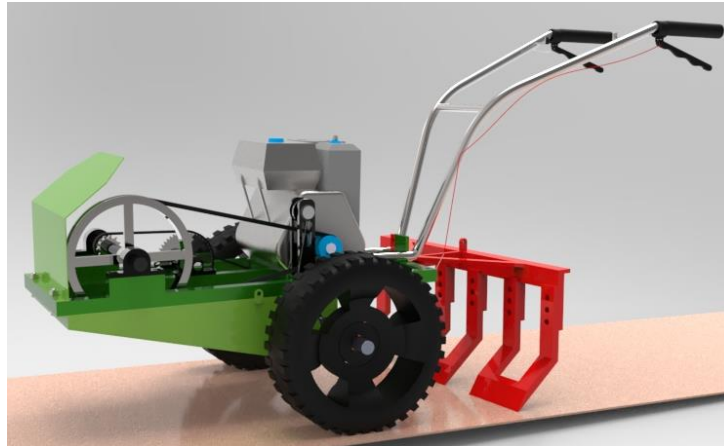


Figure 1.6 Rendered model of final concept weed removal attachment

Physical Model base product with attachment



Figure 1.7 Final physical mode of groundnut weed removing machine with blades

Conclusion

Weed removing is a crucial aspect of farming, traditionally performed manually by farmers. However, with the growing demand for food and sustainable practices, it is imperative to adopt new techniques that enhance crop production. The selection of the most suitable harvesting method is essential. To address this need, three concepts were developed and evaluated using the PUGH matrix. The best concept was then customized to cater to the needs of small and medium-scale farmers. This innovative weed removing attachment not only reduces costs but also saves valuable time compared to the manual method. Extensive research has shown that it is highly cost-effective, efficient, and beneficial for small and medium-scale farmers. The final concepts prototype physical model were made this product fulfill the user needs.

References

- [1] Albert Francis A, Aravindh R, Ajith M, Barath Kumar M (2017), "weed removing machine for agriculture", International journal of engineering sciences & research technology, Francis et al., 6(5).
- [2] Sakthi P and P.Yuvarani (2018), "Detection and Removal of Weed between Crops in Agricultural Field using Image Processing", International Journal of Pure and Applied Mathematics, Volume 118 No. 8 2018, 201-206
- [3] TejasBadkhal, Rohit Sharma, IqveSonu, Sanket Patil, Dr. Rahul Mapari (2019), "Automatic Weed Killing Robot for Agriculture Purpose and Insect Killing", International Journal of Research in Advent Technology, Vol.7, No.1,
- [4] Pushpavalli M,(2018), " Design and Development of Automatic Weed Detection and Removal System", MAT Journals , Journal of Signal Processing ,Volume 4 Issue 1
- [5] Leonardo Enrique SolaqueGuzmán, Marianne Lorena Romero Acevedo and Adriana RiverosGuevara, (2019), "Weed-removal system based on artificial vision and movementplanning by A* and RRT techniques", ActaScientiarum. Agronomy, v. 41.
- [6] A.N. RAO, Ravi Gopal Singh, Gulshan Mahajan, S.P. Wani, (2018), "Weed research issues, challenges, and opportunities in India", 0261-2194/ © 2018 Elsevier Ltd. All rights reserved.
- [7] Uma Maheswari M and A Karthik, (2019), "Recent Trends and Techniques of Weed Management Practices in Organic Farming", Acta scientific agriculture (ISSN: 2581-365X), Volume 3 Issue 2.
- [8] Sridhar.H .S(2013), " Development of Single wheel multi use manually operated weed remover", International Journal of Modern Engineering Research , Vol. 3, Issue. 6, Nov - Dec. 2013 pp-3836-3840.
- [9] Sri madhu1 M, Siva D, Satyanartayana G, Avinash D, Lokesh M, Ramya sri K, (2022), "A case study on weed management and its techniques", YMER, Volume 21 : Issue 6
- (10) Robert G White (1977), "Matching Tractor Horsepower and farm implement size", extension bulletin E-1152 SF 11
- (11) Liz Hutton & John O'Conno, (2021), "Estimating tractor power needs", Primefact DOC21/78404, First edition. Adapted from NSW Farmers factsheet, <https://www.aginnovators.org.au /initiatives/ energy/information- papers/estimating-tractor-power-needs>