Agro Based Weeding Machine

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ABSTRACT

The weeds are plants which are considered undesirable in agriculture and gardening. The process of removal of these weeds from crops is called weeding. Weeders are mechanical machines which are used for weed removal. The paper discusses about design develop and optimize weeding machine. It is the most widely used weed control method. The use of mechanical weeder will reduce drudgery and ensure a comfortable posture of the farmer or operator during weeding. This will resultantly increase production.
India is an agricultural country. But traditional farming techniques are being replaced by modern techniques which use advanced machines in very simple manner. Weeding machine (weeder) is also one of them. The weeder is used for removing weeds in vegetable gardens, basins of orchard trees and Vineyard plantations. Besides manual, power weeders are getting popular now-a-days for their ease of use feature. In general, diesel engines are employed in them. Also there are variety of attachments available in the market for the weeder making it a multi-purposeful.

Keyword : - *Farmers,Engine,Equipment,Weeding, etc….*

1.INTRODUCTION

India is a agricultural country. More than 70% of its population is dependent on agriculture for their living, still many of the farmers use conventional methods to remove weed. Thus there is a need to bring in new modern technologies to make farming easy and time saving. To achieve a high yielding vegetable production, good agricultural practices are required. One of the most important practices is to properly manage weeds. Weeds affect crop yield due to competition to acquire plant nutrients and resources Weeds have very fast growth rates compared to crops, and if not treated and managed, they may dominate the field.

Another weed control method that is practiced is to increase the crop density in the field. By filling the field with crops, weed seed germination rates are reduced. However, the distance between plants are reduced and might affect other field operations such as fertilizer spraying or harvesting. Weed management is a strategy that makes a desired plant population successful in a particular agro ecosystem using knowledge of the ecology of the undesired plants that is the weed.

The most effective method of weed management is by making physical contact with the weeds themselves, which is weed control. Currently, there are several ways of controlling weeds, either by using manual, chemical, mechanical or biological means. The earliest and the simplest weed control method is manual weed control. Agriculture is the main occupation in majority of developing nations such as India, Brazil, etc. One major reasons for lack of yield per unit agricultural area in these nations are weeds. Weeds compete for space, nutrients, water and light with crops.

1.1 Problem statement:

The bullock implements require the hand and body pressure to achieve depth and alignment of the implement in use, whereas in soil tiller and weeder, the implements are mostly self guided. This reduces human drudgery to a great extent. The comparative higher output of operation by the soil tiller and weeders as compared to bullocks reduces the operational time and achieves timeliness in operation. Cost wise the soiltiller and weeder should be an obvious choice of smaller farmers, if they are intending to have a mechanical power source for farm-operation. Soil tiller and weeder reduce the drudgery of collecting the waste grass between crops in the field during operations as compared to operations by bullocks. The soil tiller and weeder make the manual of that wastage grass by cutting it in small piece and thoroughly mixed with soil during operation. Hence we the group of engineer has

decided to make a system called as mini soil tiller and weeder to reduce the human effort as compared to operation by bullocks.

1.2 .Objective:

1. The objective of the project is to design, construct and test automatically operated portable weeder, to provide the best opportunity to farmer's to easily control and removing the weed from farm.
2. Commercial farming system hence mechanical weeder is necessary to reduce the labour force.
3. Environmental degradation and pollution caused by chemical is reduced by the use of Mechanical weeder. Low effective operation, high work effort and high time requirement for different types of hoe or cutlass, can be overcome with the use of mechanical weeder.
4. Presently in India, weeding with simple tools such as cutlass, hoe etc. is labour intensive and intensive and time consuming. Thus, there is a need for the design of manually operated weeder for intensive and commercial farming system in India.
5. For this study we are developed mechanical power weeder by power of vibrator engine.

2. LITERATURE REVIEW :

Weed removal is one of the major activities in agriculture. Chemical method of weed control is more prominent than manual and mechanical methods. However, its adverse effects on the environment are making farmers to consider and accept mechanical methods of weed control. Chemical weeding is the most extensively used method of weed removal . But these chemicals used for weeding are harmful to living organisms and toxic in nature. Research has been carried out to use some combination various methods of weeding.

[1] Md. Aqib Naqu[1] et. al The soil tiller and weeder is one of the many farm mechanization in promoting soil tiller and weeders especiallyconsidering the fact that the majority of farmers are having small land. It reduces human effort.The implements are mostly self guided.

[2] Rajapakse N. [2] et. al Lack of man power has been identified as one of the major problems for the sustainability ofthe Sri Lankan paddy industry. Hence transplanters and seeders were well developed as a step formechanization.

[3] Philip Oguntunde and Olawale John Olukunl[3] et. al The operations involved in the crop production cycle include land clearing, land forming/ land leveling, tillage, and crop establishment, harvesting and post harvest operations. Crop establishment is necessary to eliminate the effect of weeds.

[4] WaghmodeR.S[4] et. al The present research has dealt with solar rotary tiller design for the power tiller that is made for using in primary and secondary tillage. Comparative study for portable weeders and power tillers in the Indian market is discussed. Various methods used for weed removal in crops are also discussed.

3. CONSTRUCTION :

3.1. Main component of the weeding machine

1. **Engine:-** The engine is the vehicle's main source of power. The engine uses fuel and burns it to produce mechanical power. The heat produced by the combustion is used to create pressure which is then used to drive a mechanical device.
2. **Gear Box:-** The purpose of a gearbox is to increase or reduce speed. As a result, torque output will be the inverse of the speed function. If the enclosed drive is a speed reducer (speed output is less than speed input), the torque output will increase; if the drive increases speed, the torque output will decrease.
3. **Wheels:-** reduce friction. Instead of simply sliding over the ground, the wheels dig in and rotate, turning around sturdy rods called axles.
4. **Chain and sprocket :- :-**Chain and sprocket drives are used to transmit power from one component to another. Specifically, they transfer speed and torque through the use of a linked chain and sprockets.
5. **Bearings:-** The bearings serve to reduce friction and allow for smoother rotation. This cuts down on the amount of energy consumption. This is the single most important function of bearings.

6. **Belt drives**:- Belt drives are known as flexible machine elements. This type of element has the advantage of being able to absorb significant amounts of shock and vibration. The primary function of all belt drives is the transmission of power from a source, such as an engine or electric motor to a variety of devices.

4. ACTUAL MACHINE:

5. DESIGN CALCULATIONS :

5.1. Calculations for Power Required To Weeding Machine

Power required to weeding blade

Power = Soil resistance × Area × Velocity

Soil Resistance (S.R) = 1.05 Kgf/m^2

$= 1.05 \times \frac{9.81}{0.0001} N/m^2$

$= 103005\ N/m^2$

Area (A) = Depth of Cut (mm) × Width of Cut (mm)

$= 5 \times 0.25$

$= 27.5 \times 10^{-3} m^2$

Linear Velocity (V) = $\frac{\pi DN}{60} \times \mu$

Where,

μ = Coefficient of Friction = 0.1

N = 500 R.P.M.

Linear Velocity = $\frac{\pi \times 340 \times 500}{60 \times 1000} \times 0.1$
=0.89117 m/s
So,
Power = Soil resistance × Area × Velocity
Power = 103005 × 27.5 × 10^{-3} × 0.89117
= 2524.38 W
$= \frac{2524.38}{746}$ hp
=3.3838 hp

Total Power
$P = \frac{\text{Power}}{\eta}$
$= \frac{3.3838}{0.80}$
= 4.22 hp
Where,
η = Transmission efficiency

5.2. Power required for wheels

Power required for wheels is determined using Air Resistance and Rolling Resistance
So,
Power required for wheels is 0.031 hp
Total power required for weeder machine is,

$P_{Total} = P_{blade} + P_{Wheel}$
= 4.22 + 0.031
≅ 4.25 hp

So,
Maximum power required considering some accessories power and losses,

$p_{Total} \cong 4.25$ hp

5.3. Specification of engine

- No of cylinders=1
- Rated output =4 hp
- Speed =1800 rpm
- Compression ratio =22:1
- Tank capacity =4.5 litres
- Weight of the engine =43 kg
- Direction of rotation = Clockwise
- Bore × stroke =74 ×74 mm

5.4. Design Of Shaft
Input Data:

Material-C30
Tensile Strength =490-588 mpa
Yield Stress = 294 mpa
Assume Factor of Safety =20
Power = 4 hp
Ƞ = 0.8

Shear Stress (τ) = $\frac{\text{tensile strengh}}{\text{factor of safety}}$

$$\tau = \frac{500}{20}$$

ii. Calculation of speed of intermediate shaft :
we know that,

$n_1 \times d_1 = n_{2\times} d_2$

n_1 =1800 rpm n_2 =?

d_1 =76 mm

d_2 =254 mm

1800 × 76 = n_2× 254

n_2 = 540 rpm

iii. Torque calculation :
P = 4 hp
= 4 × 0.80 × 746
= 2387.2 watt

P = $\frac{2\pi NT}{60}$

T = $\frac{2387.2\times60}{2\pi\times540}$

T = 42214.9 N.mm

iv. To find the shaft diameter :

T= $\frac{\pi}{16} \times \tau \times d^3$

d^3 = $\frac{42214.9\times16}{2\pi\times25}$

Where,
d=Diameter of the shaft
Therefore we are going to use two shaft of diameter 24.5mm.

5.5. Design Of Belt Drive :

i. Selection of open belt drive using V- belt :

Reduction ratio = $\frac{1800}{540} = 3.33$

A) Engine pulley (D_1) =76 mm

B) Intermediate shaft pulley (D_2) =254 mm
Input Data:
1. Input Power = 2984 watt

2. Input Speed = 1800 Rpm
3. Center Distance (C) = 420 mm
4. Max Belt Speed (V)= 1600 m/min =26.67m/sec
5. Coefficient Of Friction between Belt and Pulley = 0.25
Allowable Tensile Stress = 2.5 N/mm2

From Design Data (Pg No.7.58),

1) Usual Land Of Drive = 0.75-5 kw
2) Nominal Top Width W =13 mm
3) Nominal Thickness T =8 mm
4) Mass of the one meter length of Belt (M) =0.106 kgf

i. Finding wrap angle for small & big pulley

$$\sin\beta = \frac{R_2 - R_1}{X} = \frac{D_2 - D_1}{2X}$$

$$\sin\beta = \frac{254 - 76}{2 \times 420}$$

$$\alpha = 12.23^0$$

αs =180¯2β =180¯2×12.23 =155.54°=2.71 rad
αb =180+2β =180+2×12.23=204.46°=3.56 rad

Where,
αs = wrap angle for small pulley
αb = wrap angle for big pulley Now,
Mass of the one meter length of belt (M) =0.106 kgf
Centrifugal Tension (Tc) =MV2 =0.106 × 26.672 Tc = 75.39 N
Tension in tight side of belt = T_1= T¯T_C= 45999 ¯75.397 T_1= 45.923 N
Tension in slack side of belt (T_1)

$$2.3\log\left[\frac{T_1}{T_2}\right] = \theta \times \mu \times \csc(\beta)$$

$$= 0.25 \times 2.8 \times \csc(20)$$

$$\log\left[\frac{T_1}{T_2}\right] = 7.27$$

$$T_2 = 25.28N$$

ii. Power Transmitting Capacity of Belt

P= ($T_1 - T_2$) × V = (45.923¯25.28)
P=550.54 KW
Hence belt can safely transmit 550.54 kw power.

iii. Length of Belt:

$$L = 2(C) + \frac{\pi \times (D_1 + D_2)}{2} + \left[\frac{(D_2 - D_1)^2}{4c}\right]$$

$$L = 2(420) + \frac{\pi \times (254 + 76)}{2} + \left[\frac{(254 + 76)^2}{4 \times 420}\right]$$

L=1377.22

iv. Selection of Belt:
From STD manufacturer's catalogue MAKE: PIX Result Table

1) Belt Selected A- 56
2) Tight Side Tension T1 = 184 N
3) Slack Side Tension T2 = 25.28 N
4) Engine Pulley Diameter (D1) D1= 76 mm
5) Pulley Diameter (D2) D2 = 254 mm

5.6. Sprocket & Chain

For 1 rotation of the wheel the weed remover should rotate 3 times that is the requirement.

There fore the speed ratio required is **i =3.** So, we choose Big sprocket of diameter $\mathbf{d_1}$**=150mm**.

Small sprocket of diameter $\mathbf{d_2}$**=50mm.**

Thus satisfying the condition, $\left({}^{d_1}/_{d_2}\right)$ = i.

0.2=$\left(\frac{(2\times360\times500)}{(8\times10^5)\times d}\right)$

Diameter of the shaft is **d ~25mm**

5.7. Design of Bolt and Nut :

The material for fasteners is mild steel.
The bolt should withstand the compressive and the shear loads.
Shear strength, τ = 0.5 x compressive strength
= 0.5 x 280 = 140 N / mm2
Take safety factor as 2
Then, τ = 70 N / mm2
To find the diameter of the bolt, Area = load / stress
π x d2 / 4 = (1100+ 100x103) / 70
d = 42 mm
The standard diameter of the bolt available is 5 mm.
Considering safety factors 10 mm bolt is chosen.

5.8. Design of cutting blades :

Different parameters used in the study and have been in consideration to give safe strength and bending values for manufactured blades during weeding operation.
Length of blade = 11.3 cm Width of blade = 4 cm.

5.9. Design of Frame Structure of the frame :

L = Length of the frame=600 mm
W = Width of the frame= 375 mm
H = Height of the frame= 300 mm
T = Thickness of the frame= 5 mm

6. ADVANTAGES:

- It will save the total labour cost involved in whole weed removal operation.
- The weeds can be removed in much shorter span of time.
- It is eco-friendly and hence will not cause any health problems to the person operating the machine.
- The design is compact so that it is capable of removal of weeds from complex places.
- It will reduce the need for frequent inspection of weeds by farmers

7. APPLICATIONS :

- Large Agricultural Fields.
- Fields with Huge Quantity Of Weeds.
- Labour Deficient Regions
- Private Lawns

8. CONCLUSION & FUTURE SCOPE :

8.1. Conclusion:

It is a highly innovative design by modifying the existing lawn mower such that it is capable in uprooting the weeds rather than just mowing them. It has a compact design with the help of which it can run in uneven and narrow fields which other existing lawn mowers lack. Mostly Indian farmers consider cheap chemical sprays for the removal of weeds which causes several allergies and can cause breathing problems. This problem will be reduced and the Indian farmers will be able to clear their fields free from weeds with equipment with much lesser cost and eco-friendly in nature. It will save their time consumed as with the uprooting of the weeds directly it takes longer durations of time to grow again.

8.2. Future Scope:

As we know that due to increase in demand for chemical free vegetable crop production, farmers have started using mechanical techniques to control weed. Only difference is that instead of using conventional methods i.e. manual operation of the system farmers have started using automated mechanical machines to achieve the goal. Our project is now manually operated weeder, but in future we can make it semi/fully automatic. We can use tractor drive to fully automatically actuate the weeder blades for its future working.

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