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MECHANICAL POWER WEEDER- DESIGN AND DEVELOPMENT

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ABSTRACT:

The economical growth of any country is divided in various sectors of the business contributing for the development of the country. Indian economy is hugely dependent on the agricultural sector. The agricultural culture involves the various activities and weed removal is one of the important amongst other crop production activities. The conventional methods are less effective due to manual operations and hence there was the need of producing the weeding machine. The weeding machines have been developed by the researcher's long back but the problem is with the cost effectiveness of the machines. The cost effective weeding will help the farmers of the countries like us. The machines for weeding will help for the effective working and reduces the efforts of the workers for the task. Authors have presented the design and development of the mechanical weeding machines and its performance from the perspective of utilization in Indian conditions.

KEYWORDS: Weeding, Weeding machines, design, development of weeder, etc.

I. INTRODUCTION:

The economical developments in agricultural sector of India have opened the doors of opportunities for the researchers to develop the effective machines for betterment of the farmers. The weed control can be one of the reasons in failure of the crop production in the developing countries like India and hence this problem is to be addressed on priority. The cultivation cost will reduces with the use of machines. Manual, biological, chemical and mechanical weeding are the various methods used in the process. Every method has the own advantages and disadvantages while mechanical weeding is widely used due to the advantages. The chemical weeding may cause the effects on the environment while mechanical method will not cause pollution. The demand of good quality food is very huge in the market, now a day's people are ready to pay some extra amount if the quality is assured. To fulfill the market demand the farmers have to develop the processes and the mechanism for production of the quality crops and end user products. The objectives of the design, development and investigation carried out on weeding machine are as follows:

1. It should be available at lower cost than any other available weeding machine in market.
2. It should overcome maximum limitations of available techniques and should be universally accepted.
3. It should have flexibility for use in rows of different widths.
4. It should consume minimum possible power compared to other weeding machines.
5. Weeding cost should be less.

II. CALCULATIONS FOR TOTAL POWER REQUIRED TO POWER WEEDER MACHINE:

POWER REQUIRED FOR SELECTION OF ENGINE:

a. Power = Pressure × Area × Velocity

b. Power = Soil resistance × Area × Velocity

POWER REQUIRED TO WEEDING BLADE:

Power = Soil resistance × Area × Velocity

Where,
Soil Resistance (S.R) = 1.05 Kgf/cm^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)
= 0.050 ×0.450
= 0.0225 m^2
Linear Velocity (V) = $\frac{\pi DN}{60} \times \mu$
Where,
μ = Coefficient of Friction = 0.1
N = 160 R.P.M.
Linear Velocity = $\frac{\pi \times 375 \times 160}{60} \times 0.1$
3.146 m/s
So,
Power = Soil resistance × Area × Velocity
Power = 103005 × 0.0225 × 3.146 × 0.25 = 1822.80W
= $\frac{1822.80}{746}$hp = 2.44hp
Total Power = P = $\frac{\text{Power}}{\eta}$
= $\frac{2.44}{0.80}$ = 3.054 hp
Where, η = Transmission efficiency.

STANDARD FORMULA FOR CALCULATATION OF POWER IN HP:

Power = $\frac{S.R \times d \times w \times v}{746}$hp
Where,
S.R= Soil Resistance (N/m^2)
d = Depth of Cut (m)
w = Effective width of cut (m)
v = Linear velocity of the tine or blade at the point of constant with the soil (m/s)
And V = $\frac{\pi DN}{60} \times \mu$(m/s)

POWER REQUIRED FOR WHEELS:

Power = PW = $\frac{R \times V}{1000} \times \frac{1000}{60 \times 60}$hp
= $\frac{R \times V}{1000}$ in Kw
Where,
R= (Ra + Rr) When Vehicle moves along level road
V = Speed of Vehicle in Km/hr
Power required to drive the wheel = $\frac{Pw}{3600 \times \eta t}$in Kw
Where,
η_t = Transmission efficiency
Ra = Air Resistance (N)
Rr = Rolling Resistance (N)
Air Resistance-
Ra =Ka × A × V^2
Where,
Ka = Coefficient of Air Resistance (N/m^2)
= 0.023 [Best Streamline Shape]
= 0.031 [Average Shape Vehicle]
= 0.045 [Truck and Lorries]

A = Projected Frontal Area (m^2)
= 0.75× 0.15m^2
= 0.1125 m^2
V = Speed of Vehicle (Km/hr)
= $\frac{\pi DN}{60 \times 1000} \times 60$ m/min
= $\frac{\pi \times 0.0225 \times 160}{60 \times 1000} \times 60$ m/min
= 0.8738 Km/ hr
Therefore,
Air Resistance =Ka × A × V^2
= 0.031 × 0.1125× (0.8738)^2
= 0.002662N [It is negligible]
Rolling Resistance-
Rr = K×W
Where,
W= Total Weight of the Vehicle (in N)
=1500 N
K = "Constant of rolling resistance"
= 0.0059 [For Good Road]
= 0.18 [For Loose sand Road]
= 0.015 [For Representative Value]

Rr = KW
= 0.18 × 1500
270 N
So,
Rolling resistance = 270 N
Therefore,
R = Ra + Rr
= 270 + 0.002662
= 270.00266 N
Power required-
P = $\frac{RV}{3600 \times \eta t}$in Kw
= $\frac{270 \times 3.146}{0.8}$
= 1061.423 KW
= $\frac{1061.423}{746}$ hp
= 1.423hp

POWER CALCULATION:

1) For Blade (Tool) = 3.05 hp
2) For Wheels = 1.423hp

TOTAL POWER REQUIRED FOR WEEDER MACHINE:

$P_{total}=P_{Blade}+P_{Wheels}$
= 3.05+ 1.423
= 4.473hp
So, maximum power required considering some accessories power and losses,
$P_{total} \cong 4.473$hp

III. SELECTION OF I.C ENGINE:

- Engine type: - 2 Stroke
- Displacement:- 74.08 cc
- Maximum Power:- 4.8 PS @6000 Rpm
- Maximum torque:- 5.4 NM @ 4500 Rpm
- Fuel Type:- Petrol
- No Of Cylinder:- 1

IV. DESIGN OF SHAFT FOR REAR WHEEL:

Material Selection: - Medium carbon Steel With Carbon Content Ranging From 0.15 to 0.40 % Such as 30C8 Or 40C8

	Sut (mpa)	Syt (mpa)
40C8	560-670	320

Power :- 4.5 hp

Required Power:- 0.3319 = 4.5 * 0.746 = 3.357 kw

According to Max Shear Stress = Ssy = 0.5 Syt

= 0.5* 320

= 160 mpa

Assume Factor Of safety= 4

Permissible Value Of Max Shear Stress = Ssy/fs

= 160/4 = 40

Power = 2*3.57*N*T/60

T= 100.17 N.m

We Know That

Torque transmitted By the Solid Shaft and Find

Diameter = 24 mm

Say Standard Shaft Diameter Size = 24 mm

V. TESTING:

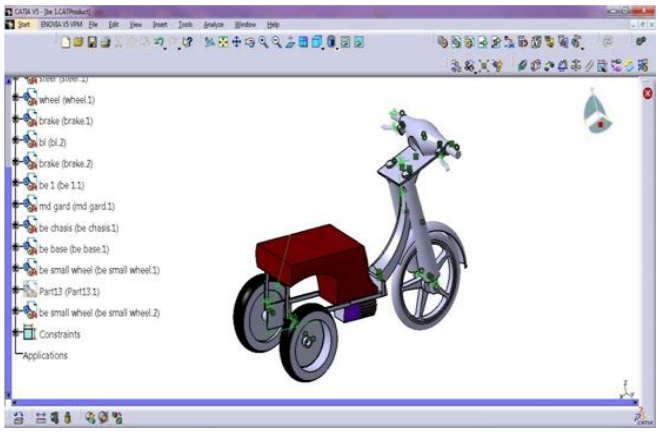

Fig. 1: Module Developed in CATIA

We tested Power Weeder machine in various types of soil farm.

Table 1: Testing Table

Sr. No.	Types of soil	Fuel consumption (ml/hr)
1	Fine soil	600
2	Medium soil	560
3	Coarse soil	510

Above table shows that Power Weeder works in different types of soil efficiently. After taking test we observed the performance of blade, transmission system, Frame. We also observed weeding capacity of machine.

VI. RESULT:

The results from this above project outcomes are assurance of much efficiency, less time consuming, worker friendly machine respective to the conventional method of Weeding. It assures you of maximum work done with minimum work effort.

Table 2: Result Table

Sr. No.	Particulars	Parameter per acre
1	Fuel consumption	2.22 Lit/acre
2	Working time	3.7 hr/acre
3	Working cost /Day	160Rs/acre

VII. CONCLUSION:

The plants growing when not required will affect the life of the other plans as a result turns in to the failure of the farmer. In India, major percentages of people are dependent on the farming for even their day to day expenses. Every stage of the farming has several reasons for failure and must be completed in the specified time for effective cultivation. The authors have developed the machine for the effective weeding as it is one of the important stages is cultivation of the crop. The complete design stages of the machine have been discusses in this paper. The machine will found useful for the farmers due to cost effectiveness.

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