International Journal of Multidisciplinary Research and Development

Volume :2, Issue :4, 402-405
April 2015
www.allsubjectjournal.com
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

HP Pathade
Production Engineering,
Pune University,
Sangamner,
Maharashtra, India

Priya Shinde
Production Engineering,
Pune University,
Sangamner, Maharashtra,
India

Nilesh Magar
Production Engineering,
Pune University,
Sangamner,Maharashtra,
India

Sainath Mundaware
Production Engineering,
Pune University,
Sangamner, Maharashtra,
India

Correspondence:
HP Pathade
Production Engineering,
Pune University,
Sangamner,
Maharashtra, India

Multipurpose weeding machine

HP Pathade, Priya Shinde, Nilesh Magar, Sainath Mundaware

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.

Keywords: Weeding machine, production, drudgery.

1. Introduction

A weed is essentially any plant which grows where it is unwanted or in the wrong place at the wrong time and doing more harm than good. It is a plant that competes with crops for water, nutrients and light. This can reduce crop production and decrease the value of land, increase cost of cleaning.

Weed control is one of the most difficult tasks in agriculture that accounts for a considerable share of the cost involved in agricultural production.Weeding is the removal of unwanted plants in the field crops. Mechanical weed control is very effective as it helps to reduce drudgery involved in manual weeding , it kills the weed and also keeps the soil surface loose ensuring soil aeration and water intake capacity.

Farmers generally expressed their concern for effective weed control measures to arrest the growth and propagation of weeds. 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. Manual weeding is common in Nigerian agriculture. Today the agricultural sector requires non-chemical weed control that ensures food safety. Consumers demand high quality food products and pay special attention to food safety. These mechanisms contribute significantly to safe food production.

2. Construction:

Different components of multiple purpose weeding machine are:

i) Body ii) Prime mover iii) Shaft iv) V belt v)Pulley vi) Director wheel vii) Chain Sprocket viii)Blades ix)Safety Cover of Blade Shaft:

i. Body:-

The body is supporting member of the machine. The prime mover is mounted on this body at front side. The handle is attached to this body at backside. The blade shaft is also attached at front back side of this body.

ii. Prime mover:

We are use the engine as prime mover to provide power to the weeder machine. The engine is single cylinder four stroke petrol kerosene engine. The petrol is used at the start of engine and after that engine running on kerosene. The engine has specification-4 HP 1800 RPM.

iii. Shaft:

It rotating machine element used to transmit the power from one shaft to other with the help of pulley or gear. Two shafts of diameter are used, here in our project to transmit motion between two parallel shafts mounted in bearing at the end which permits relative motion of gear train.

iv. V belt:
By this belt moderate amount of power is transmitted. Power is transmitted from one pulley to another pulley only when the distance between pulleys is moderate. The material used for the belt is lather, cotton and fabric material, flexible rubber, balata belt.

v. Pulley:
It is made for the aluminum and this pulley diameter is 110 mm. The pulley is attached to stepper motor by using belt drive. When the Spur gear rotates then the pulley is rotated and transfers the motion to belt drive through motor.

vi. Chain Sprocket:
Sprocket are used to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc Here in our project the power is transmitted from intermediate shaft to blade shaft.

vii. Director wheel:
It is the wheels used to direct the weeder machine. Also the director wheels are provide support to the weeder machine.

viii. Blades:
Blades are the component which directly interact with soil and as such have major impact on the operation of the weeds.

ix. Safety Cover of Blade Shaft:
The metallic sheet is fold such that it can cover the all blade shaft at back side for protection of the operator from the sediments in soil.

3. Actual Machine:

4. Design Calculations:

A. Engine selection :

i. Power requirement:

Assumptions:

1. Soil resistance (SR) =1.06 kgf/cm^2
2. Depth of cut (d)=4.5 cm
3. Effective width of cut (w)=50cm
4. Linear velocity of blade at point of contact with soil (v) =1 cm^2/sec

Power required to dig the soil (Pd) is given by

$$Pd = \frac{Sr \times w \times v \times d}{75}$$

$$= \frac{1.06 \times 50 \times 1 \times 4.5}{75}$$

$$= 3.18$$

Total power required is given by

$$PT = \frac{Pd}{\eta}$$

Assume η=0.80
PT=3.97=4hp
Where,
η=transmission efficiency
PT=total power required

ii. 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

B. SHAFT DESIGN:

Input Data:

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

i. **Shear Stress** (τ) $= \frac{\text{Tensile Strength}}{\text{Factor Of Safety}}$

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

τ =25 mpa

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
$1800 \times 76 = n_2 \times 254$
n_2 = 540 rpm

iii. Torque calculation :

P = 4 hp
= 4 × 0.80 × 746
= 2387.2 watt

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

$$T = \frac{2387.2 \times 60}{2\pi \times 540}$$

T = 42214.9 N.mm

iv. To find the shaft diameter :

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

$$d^3 = \frac{42214.9 \times 16}{2\pi \times 25} = 8599.9$$

d=20.48 mm

d=22 mm

Where,
d=Diameter of the shaft
Therefore we are going to use two shaft of diameter 22 mm.

C. Design Of Blades:

- The interaction between soil and machines takes place at the blades thus by improving their geometry the power required and the size of machine will reduce.
- Blades are attached to a flange mounted on a rotating shaft usually by nuts & bolts.
- Types of BLADES

1)L-shaped Blades 2) C-Shaped Blades
3) J- Shaped Blades

i. Selection of shape of blade

- Weeding efficiency of l blade is 91,c is 87&j is 84 perc.ent
- Cost of operation of j blade is rs.550,c is rs.580 & for l is rs.429 rs per hector.
- L shaped blade is economical & efficient as it saves 10.88 % of weeding cost & reduces plant damage n achieve weeding efficiency upto 91%.
- So we are going to use L shaped blade.

Characteristics	C Type Blade	J Type Blade	Sweep Type Blade
Cost of operation (for fuel & labour charges Rs/ha)	580	429	550
Weeding efficiency (%)	87	91	84
Plant damage (%)	3.4	5.1	1.2
Actual Field capacity (ha/hr)	0.068	0.059	0.12
Performance Index	114.30	169.84	153.23

D. Design Of Belt Drive :

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

Reduction ratio = 1800/540 = 3.33
A) Engine pulley (D1) =76 mm
B) Intermediate shaft pulley (D2) =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

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

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

$$\propto = 12.23^{\circ}$$

$\alpha_s = 180 - 2\beta = 180 - 2\times 12.23 = 155.54° = 2.71$ rad
$\alpha_b = 180 + 2\beta = 180 + 2\times 12.23 = 204.46° = 3.56$ rad
Where,
α_s=wrap angle for small pulley
α_b=wrap angle for big pulley
Now,
Mass of the one meter length of belt (M) =0.106 kgf

Centrifugal Tension (Tc) $= MV^2 = 0.106 \times 26.67^2$

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_2)

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

$$= 0.25 \times 2.8 \times \operatorname{cosec}(20)$$

$$\log\left[\frac{T_1}{T_2}\right] = 0.86$$

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

$$T_2 = 25.28\ N$$

ii. **Power Transmitting Capacity of Belt**

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

iii. Length of Belt:

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

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

$$L = 1377.22\ mm$$

L =1400 mm

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

E. Design of Frame

- STRUCTURE OF THE FRAME

L = Length of the frame=600 mm
W = Width of the frame= 160 mm
H = Height of the frame= 205 mm
T = Thickness of the frame= 5 mm

1. Advantages :

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

2. Applications :

1) Large Agricultural Fields.
2) Fields with Huge Quantity Of Weeds.
3) Labour Deficient Regions
4) Private Lawns

3. 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.

4. References :

Books:

1. Machine Design – R. S. Khurmi & J. K. Gupta
2. Design Data & Hand Book – K. Mahadevan & Balaveera Reddy
3. Production Technology- M.S. Mahajan

Research Paper -

1. ASAE, 1986. Agricultural Machinery Management Data. D230-4. American Society of Agricultural Engineers. Pp. 159-163
2. Lavabre, E. M. (1991). Weed Control. Macmillian Education Ltd., London
3. Singh, C. M., Moodey, J. and Cho, S. C. 1981. The Efficiency of the Rolling Weeder in Controlling Weeds in Dry-Seeded Rainfall Rice. Paper presented at the cropping system seminar. International Rice Res. Institute. Los Banos, Phillipines, Feb.24.
4. Singh, C. M., Moodey, J. and Cho, S. C. 1985. Weed Control through Inter-Row Cultivation in Upland Rice. AMA. 16(3): 34-40.