Design and Development of Mini Powered Weeder

M. Devaiah[1]*, Subhash Kamal[2], K. Arun Kumar[1],

[1]Department of Mechanical Engineering, Geethanjali College of Engineering and Technology, Hyderabad.

[2] MGM's College of Engineering and Technology (MGMCET) Panvel, Navi Mumbai.

**Corresponding author: devaiah.malkapuram@gmail.com*

Abstract: *Power soil tiller and weeders are occasionally termed as walking tractors have been conceived as an equipment to prepare seedbeds with rotary tillers. This weeder runs by means of power developed by a two stroke engine and the power is transmitted by series of chain and sprockets to the cutter or tiller. The main reason behind developing this project is considering the fact that the majority of farmers are having small land. So they can hardly afford costlier tractors. Therefore, the soil tiller and weeder should become a useful machine in the internal cleaning of crops which having small distance between them like Chilli , Cotton, soya bean crops, cultivation of paddy, in particular, and other crops in general for the smaller farmers. Its main objective is to reduce the cost of fabrication and also to reduce the manpower as in today's scenario labours are very hard to find as well as it reduces the working time.*

Keywords: **Walking Tractors, Cutter, Soil Tiller, Weeder, Seedbeds**

1. INTRODUCTION

The history of Indian agriculture dates back to Indus valley civilization Era and even before that in some parts of Southern India. Agriculture is the backbone of Indian economy. India ranks second worldwide in farm outputs. As per 2018, Agriculture employed 50% of the Indian work force which is 31% in 2014 and contributed 17-18% to country's GDP(gross domestic product) which 15.4% in 2016. India ranks first globally in terms of highest net cropped area followed by US and China.

One of the major reasons for reduction in productivity of agricultural field crops in the country is due to lack of mechanization from sowing to harvesting especially at critical stages viz., weeding and intercultural operations. Weeding is one of the most difficult tasks in an agricultural farm that accounts for a major share in the cost of agricultural production. In a study the loss due to soil erosion was assessed to be 13.6 % and that due to insect and diseases was 35.8% while the losses due to weeds alone was assessed to be 33.8% (Biswas et al., 1993). The reduction in yield due to weeds alone is estimated as 16 to 42% depending on the crop and location. An analysis reveals that one third cost of cultivation is being spent for weeding alone. Therefore, timely control of weeds must be given high priority for boosting of agricultural production.

Weeds are serious menace to crops. Weeds compete with crop plants for nutrients, soil moisture and sunlight. The intensity of weed competition depends upon type of weed species, severity

of infestation, duration of weed infestation, competing ability of crop plants and climatic conditions which affect weed and crop growth. They reduce the yield of crops and farmer's income as it affects crops growth and development in many ways.

2. CAlCULATION OF POWER REQUIRED

Standard formula for calculation of power

$$P = SR \times d \times w \times v \ KW$$

Where, P= power required to dig the soil

SR= Soil resistance, N/mm2

For silt soil it is 0.35 to 0.7 kgf/cm2 for loam soil (basvarajet al 2016)

d = depth of cut, m

w = effective width of cut, m

v = speed of operation, m/s

$$v = \frac{\pi DN}{60} \times \mu$$

Where,

μ= Coefficient of Friction = 0.1

D= Diameter of Shaft = 20 mm

N= 40 R.P.M

So,

Linear Velocity (v) = 0.83 m/s (40 rpm)

Soil Resistance (S.R) = 0.5 kgf/cm2

= 49033.2 N/m2

Width of cut (w) = 0.4 m

Depth of cut (d) = 0.08 m

P = 49033.2x0.08x0.4x0.83

= 1465.11 watts

1 HP = 742 watts

P =1.99 hp

Total Power required

Pt = P/η

Where Pt = total power required

η = efficiency of chain transmission = 0.8

P = power required to dig the soil

Pt = 1.99/0.8

Pt= 2.211 hp

So, In view of sudden resistance offered by the field soil, high rolling resistance offered by clay soil in kharif and availability of standard size of engine in the local market, therefore selection of 5hp engine is recommended which is commonly available in the market.

3. MATERIALS AND METHODS

The factors which are considered while selecting material included amenability of the material to the fabrication process and easy availability/adaptability for the material. Materials which are brittle in nature must be avoided as there will be continuous vibration and impact while machine is in agricultural field. Selections of materials were also based on strength, toughness and hardness to resist failure due to deformation impact and were respectively during the service loading.

The new components design dimensions were influenced by the pertinent crop parameters like row spacing, plant height etc., The blades of the weeder were made from cast iron and all other components were made from mild steel. The main components of the weeder were shown in figure 1 and 2.

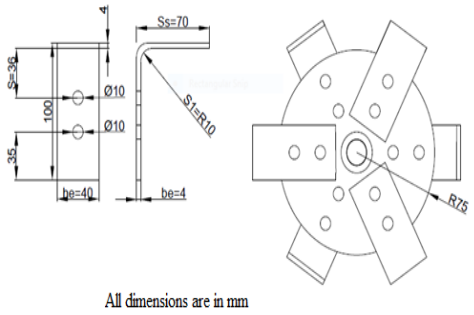

Figure 1. Showing design of cutting blades

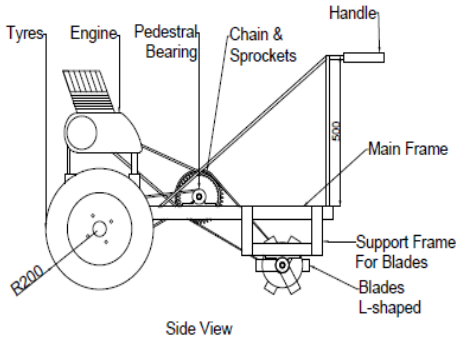

Figure 2. Schematic side view of power weeder

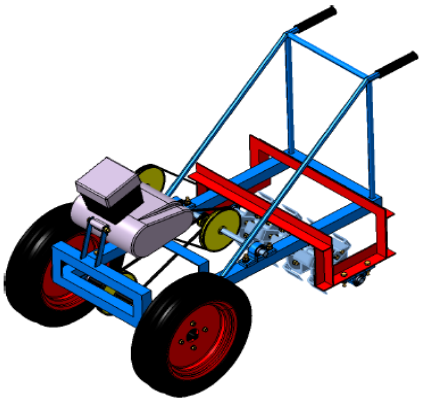

Figure 3. 3D-view of developed model

Table 1. General specifications of power weeder

S. No	Particulars	Value
1	Power source	98 cc (5.7 HP) -2stroke petrol engine
2	Weeding width & depth	400 mm & 60 mm
3	No. of blades	6
4	Rotor speed	290 rpm
5	Material of blades	Mild steel L-type blade
6	Fuel Consumption	1.5 litre/hectare

4. RESULTS AND DISCUSSION

The objective was to determine field capacity, efficiency of the power weeder and to compare its performance with other prevalent methods of weeding, namely, manual weeding (Khurpi) and existing power weeders.

Field Capacity

C= Field capacity (ha/h)

$$= \frac{areacovered,\ ha}{Time\ taken\ to\ cover\ the\ test\ area,\ h}$$

Weeding Efficiency

Weeding Efficiency

$$(e) = \frac{n1-n2}{n1} \times 100$$

Man-h/ha for Khurpi

Man (h/ha)

$$= \frac{labourengagedincertainarea}{Areainha} \times \text{time taken in h}$$

Man-h/ha for power weeder

Man (h/ha)

$$= \frac{labourengagedincertainarea}{Areainha} \times \text{time taken in h}$$

Table 2. Comparative study of weeding implements for Cotton crops

S.No	Particulars	Weeding Implements	
		Khurpi	Power weeder
1	Weeding Efficiency (%)	97.24	88.56
3	Field Capacity (ha/h)	2.5×10-3	0.155
4	Man-h/ha	16	6
5	Cost of operation Rs per ha	3260.1	502.2

The calculated test results in respect of khurpi and power weeder for weeding efficiency, field capacity (ha/h), man- h/ha, ratio of man-h to cost of operations Rs. per hectare is recorded in Table 2for the cotton crop.

5. CONCLUSION

Power weeders are one step towards the standardization of practices, e.g. it has a fixed max rotational speed, fixed direction of movement, and it goes from one side of the field to another. Conversely, manual weeders still rely heavily on the characteristics of the operator(s), which cannot obviously be standardized. It is affecting speed, direction of movement, and the movement needed to operate a weeder, e.g. back and forth or constant push.

6. REFERENCES

[1] Bajwa, A.A. 2014. Sustainable weed management in conservation agriculture. Crop protection, 65:105-113.

[2] Biswas, H.S. and Yadav, G.C. (2004). Animal drawn weeding tools for weeding and intercultural in black soil. Agril. Engg. Today, 28(1-2): 47-53.

[3] “Design of Machine Elements”, V.B.Bhandari, McGraw-Hill publication.

[4] International Journal of Modern Engineering Research (IJMER) Vol. 3, Issue. 6, Nov - Dec. 2013

[5] Khurmi, R. and Gupta, J. (2003). A text book of machine design. Eurasia Publishing House (Pvt.) Ltd., Ram Nagar, New Delhi (INDIA).