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Design and Development the Manually Operated Root Wash Paddy Transplanter Machine

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ABSTRACT

In India rice crop is planted in virtually all the states on 43.95 Mha area. The total rice engenderment of India was 106.5 Mt in 2013-14. The common method of rice cultivation practiced in India is broadcasting method, seed are sown broadcast by hand and transplanting by hand. At transplanting time, there is acute shortage of labour wage and delay transplanting operated. In India wash root type seedlings are transplanted in field so need of mechanization for transplanting wash root type seedling. The newly developed manual paddy transplanter for wash root seedling is tested and satisfied farmers condition.

Key word: *Design, Paddy, Transplanter, Wash root, Seedling, Labour*

INTRODUCTION

Rice is one of the main grain crop of India. Moreover, this country has the most immensely colossal area under rice cultivation, as it is one of the principal pabulum crops. It is in fact the ascendant crop of the country.In India rice crop is planted in virtually all the states on 43.95 Mha area. The total rice engenderment of India was 106.5 Mt in 2013-14[1]. The common method of rice cultivation practiced in India is broadcasting method, seed are sown broadcast by hand. This method refers the scattering method of seed on the surface of seedbed manually. This method is practiced in those areas which are comparatively dry and less fertile and do not have much labour. It is easiest method requiring minimum input but its yield is also minimum. The other common method for paddy cultivation is transplanting. Transplanting is most laborious consuming operation during paddy cultivation. The cost of puddling and transplanting share 50 percentage of the total producing cost. The man day required for transplanting ranging from 50-60 man-day/ha. Now a day labour are very costly and scares. The delay in transplanting directly affect the yield. Hence the transplanting operation needs to mechanized.At transplanting time, there is acute shortage of labour wage and delay transplanting operated. Hence there is urgent need to have mechanization in rice production which is reduce labour use and time consume.

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Manually operated wash root type paddy transplanter is a solution of marginal and small farmers. A new manual paddy transplanter was designed and developed for wash root type of seedling.

MATERIAL, METHODS AND RESULT, DISCUSSION

Design of paddy seedling transplanter

Design of chain derive

The load capacity of a chain is based upon the rate of wear rather than on the ultimate strength. Because is mainly due to the hinge action as the chain engages or leaves a sprocket, the rate of wear is greater than smell sprockets than with large ones. The rate of wear is directly related to chain speed and inversely related to chain length. As a chain wears, the pitch length increases and the chain rides farther out on the sprocket teeth. The more teeth is sprocket has, the sooner the chain will ride out to far and have to be replace. For this reason, speed ratio should not exceed 10:1 for standard pitch roller chain or 6:1 for other chain.

Chain selection is for extremely slow drives is sometime based on ultimate strength rather than wear rate. With roller chain, the recommended maximum ratios of working load to ultimate strength range from 0.2 at 0.13m/s to 0.1 at 1.3 m/s. conventional steel detachable-link chain has inherent stress concentration points that promote early fatigue failures if the chain is loaded to more than 10 % of its ultimate strength.

The diameter of the roller(d_r) and width of chain (b_c) should be 5/8 of chain pitch, while the diameter of pin (d_p) may be taken of the half of roller diameter. The thickness of the link plate (t_p) should be one fifth of the roller diameter.

Width between outer plates (b_0) can be calculated by equation

$B_0 = b_c + 2_{tp}$

Maximum height of pin link plates, i.e. outer plate (h_0), may be taken as 0.82 times pitch while maximum height of roller link plate, i. e. the inner plate (h_i), should be 0.95 times pitch.

The length of roller (I_r) can be calculated using the following empirical relation:

$I_r = 0.90\ b_i - 0.15$

Where b_i = with between inner plates.

Preferred number of teeth on sprocket are 17, 19, 21, 23, 25, 38, 57, 76, 95, 114. Pitch circle diameter of sprocket may be calculated using the following equation:

$D_{ps} = \frac{p}{sin\frac{180}{ns}} =$ p cosec $(\frac{180}{ns})$

The minimum, maximum and average speed of chain may be calculated using the following equation,

$V_{min} = \frac{2\pi NRp}{60} \cos \frac{180}{ns}$

$V_{max} = \frac{\pi\ Dp\ N}{60} V_{av} = \frac{p\ N\ ns}{60\times1000}$

Where N, speed of driving sprocket (rev/min); pitch radius of the sprocket (mm); D_{ps}, pitch circle diameter of driving sprocket (mm); p, pitch of chain (mm); $n_{s,}$ number of teeth on smell sprocket.

The chain speed of roller chain is given in table.

Table: maximum chain speed for roller chain

Pitch (mm)	9.53	12.7	15.88	19.05	25.4	31.75	38.1	44.75	50.8	63.8	76.2
Chain speed (m/s)	13.7	13.4	12.0	10.9	9.7	8.1	7.3	6.5	6.0	4.7	4.0
Max. pinion speed (rev/min)	3500	2500	2300	1800	1500	1000	800	600	400	300	200

Velocity ratio can be expresses as:

$$V_R = \frac{n1}{ns} = \frac{N1}{N2}$$

Pitch circle diameter of pinion may be calculated using the equation:

$$D_p = \frac{p}{sin\frac{\pi}{np}}$$

The centre distance between driving and driven sprocket should be 30 – 50 times pitch, but in extreme case it may be up to 80 times pitch.

Chain length can be calculated by multiply the number of chain links with pitch of the chain.

Number of chains links of a given pitch for a given centre distance can be calculated using the equation:

$$\mathrm{n} = \frac{2x}{p} + \frac{\mathrm{n1} + \mathrm{ns}}{2} + \frac{p(\mathrm{n1} - \mathrm{ns})2}{4\pi 2}$$

The centre distance between driving and driven sprocket can be calculated using the

$$x = \frac{p}{4}\left[n_c - \frac{n_s + n_l}{2} + \sqrt{\left(n_c - \frac{n_s + n_l}{2}\right)^2 - 8\left(\frac{n_l - n_s}{2\pi}\right)^2}\right]$$

Chain pitch can be calculated using the equation:

$$\mathrm{P} = \frac{x}{(90\ to\ 60)} \text{ for low speed}$$

Power developed by the operator of seedling transplanter.

The power of useful work done by a human being according to Campbell, *et al*., is given by.

HP = 0.35-0.092 log tWhere t =time in minutes

$$HP = \frac{\text{pull(kgf)} \times \text{speed(ms}^{-}1)}{75}$$

$$Pull = \frac{\mathrm{HP} \times 75}{speed(ms^{-}1)}$$

Now on average a human can work on the field 2-3 hour's continuous so the power developed by operator is 0.13-0.16 hp. Now if we take working time three hour's than the power developed by a human 0.14 hp.

HP= 0.35-0.092 log (t)= 0.35-0.092 log 180= 0.35-0.092×2.24= 0.14

Now we know developed power by a chain drive

$$HP = \frac{\text{pull force (kgF)} \times \text{speed of machine(ms}^{-}1)}{75}$$

Operating speed of machine is 2.5 km/hour or 0.69 m/s

$$0.14 = \frac{\text{pull force (kgf)} \times 0.69\ (\text{ms}^{-}1)}{75}$$

Pull force = 15.21 kgf

Speed of ground wheel (N_1)

Angular velocity is given by

$W = \frac{\mathrm{V\,avg}}{r}$ avg = average walking speed of man / woman, ms^{-1}

r = radius of the wheel,

W=$\frac{.69}{.22}$W =3.13 rad/sec

Speed of driving sprocket$N_1 = \frac{w \times 60}{2\pi}$, $N_1 = \frac{3.13 \times 60}{2 \times 3.14}$ = 29.90 rpm

Spacing between successive sampling

Speed of driven shaft N_2

$N_1S_2 = N_2S_2$

N_1 = Speed of driving sprocket rpmN_2= Speed of driven sprocket

S_1 = Number of teeth of drivingS_2 = Number of teeth of driven

$$N_2S_2 = N_1S_2N_2 = \frac{29.90 \times 60}{11} = 163 \text{ rpm}$$

Linear distance travelled by the transplanter in one complete rotation of wheel or circumference of wheel.

$C = \pi \times D = 3.14 \times 44.5 = 139.73$ cm

Sprocket velocity ratio$SR = \frac{S1}{s2} = \frac{60}{11} = 5.45$

Torque on ground wheel (T_w) Nm

$T_w = K_w \times W_t \times R_w$

K_w = coefficient of rolling resistance (0.4 for metallic wheel)

W_t = Weight of machine (22kg)

R_w = Radius of ground wheel (22.25 cm)

$T_w = 0.4 \times 22 \times .2225 = 1.926$ kg.m

$$Hp = \frac{2\pi Nw Tw}{4500} = \frac{2 \times 3.14 \times 28.66 \times 4.7}{4500} = \frac{845.92}{4500} = 0.1879 \text{ hp}$$

Determination of maximum bending moment of tray

We know that the power is transfer to the machine by the chain drive after chain drive power flow to finger system. So the measurement of the bending moment of the tray or machine was measured by the theorem of the chain drive system. So load at tray

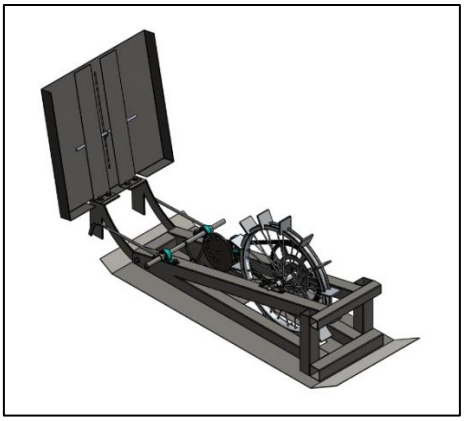
$Q = K_1 \times P_t$ KgfK_1 = coefficient of tray (1.18 for the mild steel)

P_t = pull force at tray (19.09)Q = 1.18× 1.95=2.301 Kgf

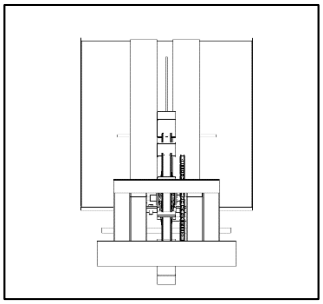
Now angle of tray is working at an angle θ (31) with the horizontal. Therefore, equivalent load on the machine was calculated

$Q_v = Q \sin \theta = 2.301 \sin 31 = 1.185$ kgf

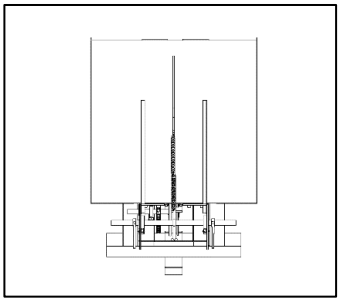
The wash root type paddy transplanter was designed with different dimension as shown in figure.



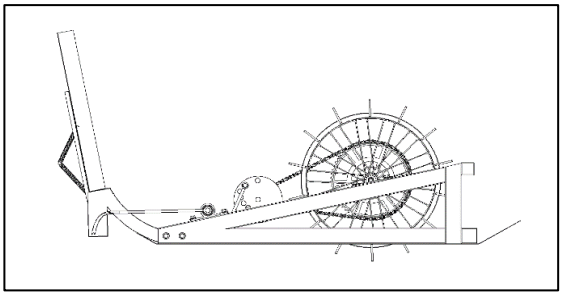
Isometric view of transplanter



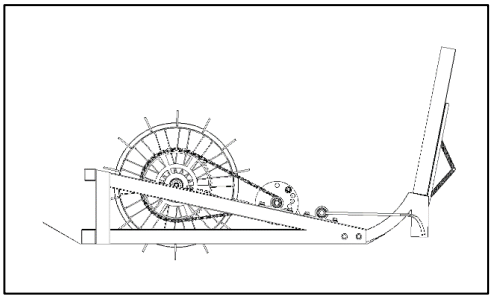
Front view



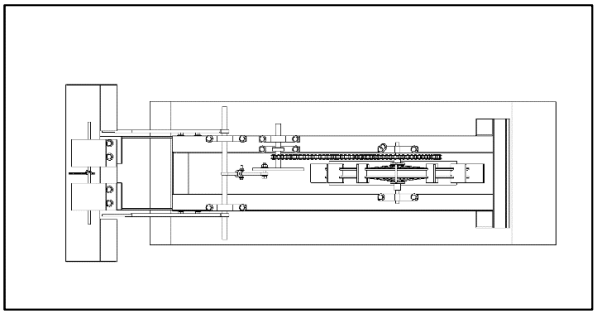
Back view



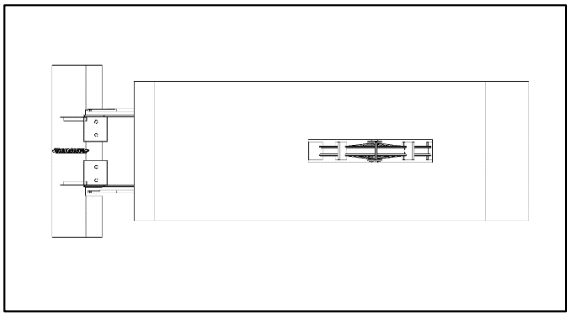
Right view



Left view



Top view



Bottom view

Graphical representation of transplanter from different angle

A prototype of manual paddy transplanterwas developed and fabricated at the Department of FMPE VIAET SHUATS Allahabad.

CONCLUSION

Most of the farmers use different transplanting methods for paddy establishment. But during the period of transplanting they spend lots of money on labours and lastly they will not gain that much as they wished or they deserved. After designing new manual paddy transplanter it was tested in field and it was found that the wash root type paddy transplanter was satisfy the local condition and suitable for small farmers

REFERENCES

1. Anonymous. Final estimates of area, production & productivity of principal crops during 2013-14 in M.S. http://www.mahaagri.gov.in (2015).
2. Ganpathi, D., & Kumar Surendra, A., "Design, development and field evaluation of manually operated rice transplanter for rice intensification" Int. J. of Agriculture, Environment and Biotechnology, 8(3), pp 735-741 (2015).
3. Patil Dhanesh, D., & Phate Dr. Mangesh, R., "Design & Development of Rice Planter Machine" *Int. J. of Innovative Research in Science, Engineering and Technology*, (2016).
4. Kumbhar Satish, Khot Sangram, Mohite Suraj and Pandit, S.V., "Design Analysis and Fabrication of Manual Rice Transplanter" *Int. J. of Innovative Research in Science, Engineering and Technology*, (2017).
5. Singh, P. K., Srivastav, H., Bind A. K., Kumar C. and Jain, R., "Rice Transplanting Machine" *Int. J. of Engineering Research and Application pp.* 71-75 (2017).