

STUDIES ON MANUAL PADDY TRANSPLANTER MACHINE FOR AGRICULTURE APPLICATION

Jhunjhun Kumar Mishra¹, T. Nani², raavi sai teja³

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ABSTRACT:- Agriculture is the most important sector of the Indian economy. It is the most important source of employment for the majority of the work force in the country. A major population in India is engaged in agriculture. Among that highest percentage was in paddy sector. Rice is the major staple food of the country. Releasing of work force to sectors other than Agriculture is important to develop the country. To release the work force in paddy sector mechanization plays a big role. To feed growing population is a huge challenge. Mechanization of paddy sector will lead to higher productivity with releasing of work force to other sectors. The objective of this project is to design a paddy transplanting mechanism to transplant paddy seedlings by small scale farmers in the country.

Keywords

Introduction, design consideration, fabrication work, Result and discussion, Conclusion

1. INTRODUCTION

A rice transplanter is a specialized machine fitted with a transplanter mechanism (usually having some form of reciprocating motion) driven by the power from the live axle, in order to the transplant rice seedlings onto paddy field. Rice is a major food grain crop of world. Unlike upland row crops, cultivation of low land rice crop is a labour intensive process. If this operation is not done in time the yield goes down. In view of this, there is an urgent need to mechanize this operation. The rice translation process is generally manual which involves number of labour. The process of manual rice transplantation is not so efficient as compared to the mechanical rice transplantation. Machine transplanting using rice transplanter requires considerably less time and labour than manual transplanting. It increases the approximate area that a person can plant. The distribution of food grain production which shows the rice production is major in India. Mechanism is needed to raise productivity in rain fed upland and rain fed lowland and to increase cropping intensity in irrigated farms. Seed drills give better plant population, reduce cost and give higher yields of rice.

2. DESIGN CONSIDERATION

The manually operated paddy transplanter was developed to transplant the mat type nursery. It can transplant the paddy seedlings in 2-rows at a time. The machine has been designed to meet the requirements of medium farmers whose investment capacity is limited but possess sufficient size of land to work within short period. The machine is hand operated.

The Rice Transplanting machine's most important mechanisms are for the planting unit, paddy seedling tray and Power transmission system and attachments.

Planting Unit When designing the planting Mechanism following aspects was considered:

- ✓ Moving pathway
- ✓ Speed of travelling
- ✓ Plant catching mechanism
- ✓ Depth of planting

2.1 Moving pathway

A four bar linkage mechanism was used to get the required measurements.

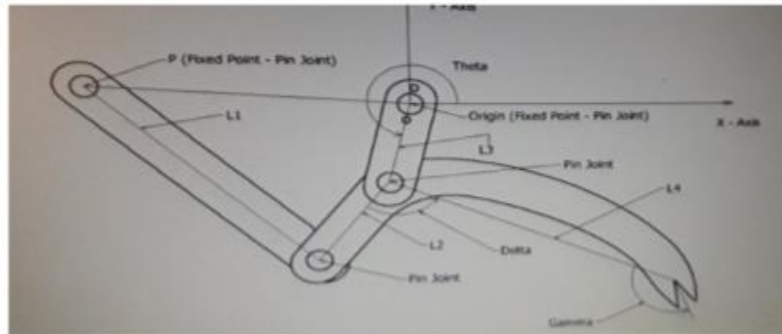


Figure 2.1. Planting Arm the trajectory of the planting unit depends on.

❖ Point P, Length L1, L2, L3 and L4, Delta

Theta is the variable which varies from 0 to 360 degree. The trajectory is plotted in MATLAB with all the variations of the above discussed variables. The optimized plot was chosen for which the values are:

- $P = (-150, 10)$ mm
- $L1 = 150$ mm
- $L2 = 60$ mm
- $L3 = 50$ mm
- $L4 = 160$ mm
- $\Delta = 101$ degree

The plot of the trajectory is shown in Appendix. Also the variation in speed is simulated. Plot of the simulation is shown in Appendix.

2.2 Plant Catching Mechanism

There are several parameters were considered in designing the plant catching mechanism:

1. Place of catching
2. Number of plant per catching
3. Distance of travel
4. Releasing Point
5. Angle of Planting

2.3 Depth of Planting

Planting depth is important for growth of roots and to stand with the submerge condition. Planting depth for the machine is set to be 50mm below the ground level.

2.4 Power Transmission system

All the power generation is achieved by wheel. Chain and sprocket mechanism is used to transmit power to the planting unit.

- No of teeth of sprocket at wheel = 24
- No of teeth of sprocket at planting mechanism = 12
- No of plants planted per wheel rotation = $24/12=2$

3. Fabrication work

Construction of screw tray indexing mechanism in saral-2 requires a high skill mechanic. This work cannot be done by a village artisan. In case of wear and tear, the screw shaft may have to be completely replaced. all parts of the machine can be fabricated by local artisan and are repairable.

3.1 Fabrication of Tray indexing mechanism of manual paddy transplanter

Tray movement mechanism is the main unit of a transplanter. This mechanism is simple in constructions. Following are the main components of tray indexing mechanism



Fig: - 3.3 Handle



Fig: - 3.4 Black Bearing



Fig.3.3. Sprocket



Fig: - 3.6 Bicycle Chain



Fig: - 4.7 Wheels



Fig: - 4.8 Shaft

- Frame base, Face plate, Slider with Face plate follower, Connector, Ratchet shaft, Bearing, Sprocket, Chain, Wheels, and Shaft etc.

3.2 Testing Parameter

Following parameters were measured during the field operation

a) Puddling index:-

It is the ratio between volume of settled soil and total volume of sample and is given by the formula (Appendix B)

$$\text{Puddling Index} = \frac{V_s}{V_t} \times 100$$

Whereas

V_s = volume of settled soil, and

V_t = total volume of sample.

For determining of the puddling index the sample of soil -water suspension shall be taken by immersing a glass tube to a depth of about 100 mm. the samples shall be taken from a number of points and shall be calculated in measuring cylinders. These shall be kept undisturbed for 24 hours, to allow the soil to settle. The volume of settled soil shall be noted for computing the puddling index by the above formula.

3.3 Theoretical Field Capacity

It is the rate of field coverage that would be obtained if the machine were performing its function 100 per cent of the time at the rated speed and always covering 100 per cent of its rated width. It is given by the formula

Theoretical field capacity, ha/h= $S \times W / 10000$

Whereas,

S = speed of travel, kmph; and

W = rated width of implement, m

3.4 Effective Field Capacity

It is the actual average rate of coverage by the machine. Effective field capacity is expressed by the formula:

Effective field capacity= $S \times W / 10000 \times Ef$

Whereas,

S = speed of travel, kmph;

W = rated width of implement m; and

Ef = field efficiency, %.

3.5 Field efficiency. It is the ratio of effective field capacity to the theoretical field capacity and is expressed in percent.

Field efficiency, % = $\text{Effective field capacity} / \text{theoretical field capacity} \times 100$

3.6 Missing index

The transplanting faults are measured to number rows planting per stroke and to the total number of seedling planted per ten strokes.

Whereas,

S = speed of travel, kmph; and

W = rated width of implement, m

4. RESULT AND DISCUSSION

The manually operated paddy transplanter developed under this project was tested to find out its

- ✓ Field capacity (ha/h)
- ✓ Field efficiency
- ✓ Miss transplanting percentage
- ✓ Economics and to determine overall performance.

The recorded observations are presented in Appendix A. The calculated values of performance parameters are presented in a below table. The operational costs under different methods are shown in Appendix C. Examples of calculation is given in Appendix D. A two row manually operated paddy transplanter was developed by incorporating following modifications in the components of popular paddy transplanter.

- Tray Indexing Mechanism, Float, Testing, Field Capacity, Field Efficiency, Labour Requirement, Mistranslating etc.

4.1 Mistranslating mainly depends upon

- ✓ The speed of operation
- ✓ Depth of standing water
- ✓ Age of seedling and density of the plant.

4.2 Economics of transplanting

1. Calculation of field capacity for developed manual paddy transplanter

$$\begin{aligned} \text{Field capacity} &= \frac{\text{Area cover in ha}}{\text{Time taken n to cover that area}} \\ &= \frac{270/10000}{40/60} = 0.041 \text{ ha/h} \end{aligned}$$

2. Calculation of speed of developed paddy transplanter

$$\begin{aligned} \text{Speed (Km/h)} &= \frac{\text{Distance(m)}}{\text{Time (s)}} \\ &= \frac{17 \times 60 \times 60}{1000 \times 156} = 0.392 \text{ Kmph} \end{aligned}$$

3. Calculation of theoretical field capacity

$$\begin{aligned} \text{Theoretical field capacity (ha/h)} &= \frac{W \times S}{10} \\ &= \frac{1.25 \times 0.39}{10} = 0.0487 \text{ ha/h} \end{aligned}$$

4. Calculation of field efficiency

$$\begin{aligned} \text{Field efficiency} &= \frac{\text{Effective field capacity}}{\text{Theoretical field capacity}} \times 100 \\ &= \frac{0.041}{0.0487} \times 100 \\ &= 84.49\% \end{aligned}$$

5. Calculation of man-h per ha

$$\begin{aligned} \text{Man-h /ha} &= \frac{\text{Labour engaged in transplanting} \times \text{time taken in h}}{\text{Area in ha}} \\ &= \frac{2 \times 40/60}{270/10000} \\ &= 50 \text{ man-h/ha.} \end{aligned}$$

5. CONCLUSION

Although self propelled rotary paddy transplanter is successful and commercially available in India, its use is limited to very large farmers due to its high cost (Rs.1.5 lakhs to Rs.6.5 lakhs). Few designs of low cost manually operated paddy transplanter have come up as a result of intensive research work carried out by various research agencies. In this context a project was undertaken with the objectives of identifying the deficiencies in the design of manual paddy transplanter. The drawbacks in the manual paddy transplanter were identified through its field testing and from users of manual paddy transplanter. The main deficiencies were related with the complicated design of screw tray indexing mechanism, high weight and poor Transportability device.

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