Performance evaluation of four row self propelled paddy transplanter for black cotton soil

Murali M, M Anantachar and B Devojee

Abstract
Field Trials were conducted at gagavathi in during kharif 2014 with view to reduce cost of transplanting operation of paddy crop. A self propelled four row paddy transplanter (Kubato Model) was used for the transplanting purpose. The performance of the mechanical self propelled paddy transplanter was found quite satisfactory. The field capacity, field efficiency and fuel consumption of the four row self propelled paddy transplanter were 0.1 ha/h, 65% and 10 lit/ha, respectively. The cost of mechanical transplanting was found to be 1500 Rs/ha as compared to Rs 5000 Rs/ha as in case of traditional method of manual transplanting followed by farmers in the region. Crop yield in both manual and mechanical transplanting was found at par with average grain yield. The machine was found to be farmer friendly and feasible in terms of time, money and labour requirement as compared to manual method transplanting of paddy.

Keywords: mechanized transplanting, four row paddy transplanter, field capacity, field efficiency

Introduction
Rice is one of the most important crop and staple food of millions of people which is grown in many countries of the world. The total area planted under rice crop in India is 42.20 million ha, which is the largest in the world as against the total area of 148.40 million ha (Anon., 2012) [1]. Paddy is largely grown traditionally by manual transplanting. Manual transplanting requires a lot of labours besides involving drudgery and is also very expensive. Scarcity of labours is another major problem in some paddy growing area of the country. Manual transplanting takes about 250-300 man hours/ha which is roughly about 25 per cent of the total labour requirement of the crop (Behera et al., 2009) [3]. Hence, less expensive, farmer friendly and labour saving method of paddy transplanting is urgently needed. The mechanical transplanting of paddy has been considered the most promising option, as it saves labour, ensures timely transplanting and attains optimum plant density that contributes to high productivity. Keeping this in view, the study was conducted on self propelled four row paddy transplanter to minimize the cost of transplanting of paddy crop through farm mechanization. Mechanical transplanter using self-propelled transplanter has been considered as the most promising option because it saves labour to the tune of 90 per cent of that required in manual transplanting, minimizes stress and drudgery, ensures timely transplanting and attains optimum plant density contributing to higher productivity (Behera and varsheny, 2003) [3].

Material and Methods
On farm testing and field demonstrations were conducted at Krishi Vigyan Kendra and Agriculture Research Station, kopal Dist. Bhandara gagavathi during kharif 2014-2015 to study the economic feasibility of self-propelled four row paddy transplanter for transplanting of paddy. The field trials/field demonstrations were also carried out on farmers’ field. The soil of the experimental site was black soil. The experiment consisted of evaluation of field performance of the mechanical transplanter in comparison with manual transplanting. For this a four row self-propelled paddy transplanter (PF4555) was used. The detailed technical specifications of self-propelled four row paddy transplanter used are shown in Table 1. Speed of operation, width of working, total time required to cover the area and the fuel consumption were recorded.

Mechanical transplanting requires a special type of seedlings raised on mat type nursery. Raised beds of 58 cm length, 28 cm width and 19 cm height were prepared. Soil was sieved and mixed with equal proportion of sand and farm yard manure and spread over the polythene sheet to a depth of 1.9 cm. Sprouted seeds were spread uniformly on the polythene sheet and pressed gently. They were covered with paddy straw and watered for four days. After the
fourth day paddy straw was removed and seedlings were
grown normally by regular watering. After 15 days the
seedlings mats were fed to the mechanical self propelled four
row paddy transplanter. In case of manual transplanting
method, paddy nursery was raised following the
recommended package of practices. Transplanting was done
using mechanical transplanter by running lengthwise of the
field on the puddled and leveled land with waterlevel in the
field kept up to 2 cm only to avoid floating of the seedlings.
Observations on speed of operation, depth of placement of
seedlings, number of seedlings per hill, number of missed
hills, time taken for turning, time taken for loading of seedling
mat on to the transplanter, total time taken for transplanting,
total area covered, width of coverage and fuel consumption
for the transplanting operation were recorded. The following
parameters were studied to study the performance testing of
the self propelled four row paddy transplanter.
1. Theoretical field capacity was calculated based on the
speed of operation and width of Cutting of the machine.
2. Actual field capacity was calculated based on area
covered and actual time taken for covering the area
including the time lost in turning.
3. Field efficiency was obtained by dividing actual field
capacity by the theoretical field capacity.

Table 1: Technical Specifications of 4 row self propelled paddy
transplanter

<table>
<thead>
<tr>
<th>Nursery used</th>
<th>Mat type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man power requirement</td>
<td>One (operator)</td>
</tr>
<tr>
<td>Operating width, mm</td>
<td>1200</td>
</tr>
<tr>
<td>Number of rows</td>
<td>4</td>
</tr>
<tr>
<td>Row to row spacing, cm</td>
<td>30</td>
</tr>
<tr>
<td>Plant to plant spacing, mm</td>
<td>100 to 210</td>
</tr>
<tr>
<td>Planting depth, mm</td>
<td>20-50</td>
</tr>
<tr>
<td>Type of fingers</td>
<td>Fixed opening type</td>
</tr>
<tr>
<td>Size of Seedling mat on the transplanter, mm</td>
<td>400 x 200 x 20</td>
</tr>
<tr>
<td>Weight of the machine without nursery mats, kg</td>
<td>200</td>
</tr>
<tr>
<td>Approximate cost of the Machine, Rs</td>
<td>2,00,000</td>
</tr>
</tbody>
</table>

Theoretical field capacity
It is the rate of field coverage of an implement, based on 100
per cent of time at the rated speed and covering 100 per cent
of its rated width.
The theoretical field capacity of machine is mainly dependent
on the width of machine and forward speed of machine.
Theoretical field capacity was calculated by using following
formula (Mehta et al., 2005) \[8\]. It is the function of speed of
transplanter and the width of operation expressed in ha/h and
it can be calculated by the following equation:

\[
T.F.C = \frac{W \times S}{10} \tag{1}
\]

Where,
T.F.C = theoretical field capacity, ha/h
W = Operating width of the transplanter, m
S = Transplanting speed, km/h

Effective field capacity
It is the actual area covered by the implement, based on its
total time consumed and its width. For calculating effective
field capacity, the time consumed for actual work and loss for
other activities such as turning and cleaning of clogged crop
residues and fuelling etc. are considered and also the effective
field capacity is dependent on field patterns. Effective field
capacity was calculated by following formula (Mehta et al.,
2005) \[8\].

\[
EFC = \frac{A}{T_f - T_n} \times 100 \tag{2}
\]

Where,
EFC= Effective field capacity, ha/h
A= Total transplanted area, ha
T_f= Total operating time required for transplanting, h
T_n= Non-productive time, h (Time loss for turning)

Field efficiency
It is the ratio between the productivity of a machine under
field conditions and the theoretical maximum productivity
and it can be calculated by the following equation: (Mehta et al.,
2005) \[8\].

\[
\text{Field efficiency (\%)} = \frac{E.F.C}{T.F.C} \times 100 \tag{3}
\]

Where,
FE = Field efficiency, per cent
E.F.C = Actual field capacity, ha/h
T.F.C= Theoretical field capacity, ha/h

Fuel consumption
Before starting the field operation, the fuel tank of machine
was filled with fuel. Then the field operation was started and
the total operating time was also recorded. After the
completion of field operation the fuel tank of machine was
refilled and the amount of refill was recorded. Then the fuel
consumption was calculated by using the following equation:
(Mehta et al., 2005) \[8\].

\[
F = \frac{F_t}{T} \tag{4}
\]

Where,
F= Fuel consumption rate, l/hr
F_t= Fuel used during operation, l
T= Total time needed for operation, h

Results and discussion

Table 2: Operational performance of the self-propelled rice
transplanter

<table>
<thead>
<tr>
<th>No of rows</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Row spacing (cm)</td>
<td>30</td>
</tr>
<tr>
<td>Actual field capacity (ha/hr)</td>
<td>0.18</td>
</tr>
<tr>
<td>Theoretical field capacity (ha/hr)</td>
<td>0.216</td>
</tr>
<tr>
<td>Field efficiency (%)</td>
<td>83.33</td>
</tr>
<tr>
<td>Labor requirement (man-hrs /ha)</td>
<td>11.12</td>
</tr>
<tr>
<td>Fuel consumption (l/hr)</td>
<td>0.9</td>
</tr>
<tr>
<td>Fuel consumption (l/ha)</td>
<td>5</td>
</tr>
<tr>
<td>Percentage of damaged hill (%)</td>
<td>3.33</td>
</tr>
<tr>
<td>Percentage of missing hill (%)</td>
<td>5.33</td>
</tr>
<tr>
<td>Percentage of floating hill (%)</td>
<td>1.67</td>
</tr>
</tbody>
</table>

The field performances of self-propelled rice transplanter
for mechanical rice transplanting shown in table. Speed of
transplanter was found as 1.80 km/hr, fuel consumption was
0.90 liter per hour and five litters per hectare of area transplanted. The actual field capacity and the theoretical field capacity were obtained as 0.18 ha/hr and 0.216 ha/hr respectively. The field efficiency was 83.33%. Percentage of damage hills and the percent of missing hills were 3.33% and 5.33% respectively. There was 1.67% floating hills for mechanical transplanting method. Percentage of damaged hill and missing hill were due to turning of the transplanter and the planting efficiency was 95%. Hill density was 28 hill/m² and the number of seedling per hill was 7.8.

References