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

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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) [5]. 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 block 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

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

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:

$$T.F.C = \frac{W \times S}{10} \quad \text{... 1}$$

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].

$$EFC = \frac{A}{T_P - T_N} \times 100 \quad \text{...2}$$

Where,
EFC= Effective field capacity, ha/h
A= Total transplanted area, ha
T_P= 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].

$$\text{Field efficiency}\,(\%) = \frac{E.F.C}{T.F.C} \times 100 \quad \text{... 3}$$

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].

$$F = \frac{F_t}{T} \quad \text{... 4}$$

Where,
F= Fuel consumption rate, l/h
Ft= 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

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

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.

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