

Optimization of paddy nursery age for manual paddy transplanter (Hand cranking type)

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■ **ABSTRACT** : This field experiment was conducted at Agronomy field, DBSKKV, Dapoli. Three different ages of nursery as 21, 28 and 35 DAS were taken for study. Plant and field parameters were measured during operation with manual paddy transplanter (hand cranked). The 21 (DAS) nursery required less time (25 min) for uprooting and preparing root washed seedlings from area of 1m² as compared to that of for 28 (DAS) (35 min) and 35 (DAS) (42 min) nursery. Missing of hills were also less in 21 (DAS) nursery. The field capacity with existing manual paddy transplanter (hand cranking) was 0.020 ha/h for 21 (DAS) nursery, whereas, for 28 and 35(DAS) nursery it was found 0.018 ha/h and 0.019 ha/h, respectively. Hence, 21 (DAS) nursery was found suitable for manual paddy transplanter (hand cranking).

■ **KEY WORDS** : Paddy transplanter, Hand cranking, Missing hills, Field capacity

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Rice (*Oryza sativa* L.) is the major staple food for more than half of the global population and considered as the “global grain”. India has largest area under rice (43.90 million ha) with the production of about 106.5 million tones, it ranks second only to China with the productivity of about 2180 kg/ha during the year 2014-2015 (Anonymous, 2015).

To meet the food demands of the growing population and to achieve food security in the country, the present production levels need to be increased by two million tones every year. To get higher yields, transplanting of healthy and vigorous seedlings is prerequisite which produces uniform crop stand with higher yield than direct seeded rice. Transplanting is done manually, which is tough and involves enormous drudgery

and human stress in sweltering weather. It requires about 300-350 man hours per hectare, which is approximately 25 per cent of total labour requirement for paddy cultivation (Das, 2012). Non-availability of labour has compounded the situation and paddy transplanting has emerged as the problem in the major rice growing areas of this region. This results in delay in transplanting and decrease in yield. In spite of the huge labour requirement, plant to plant and row to row spacing are not achieved, hence, mechanical weeding is not possible. So also, the scarcity of labour at peak demand period results an increased cost of operation and delays the transplanting operation. Therefore, it is high time for mechanizing the transplanting operation in rice seed production fields.

Mechanical transplanting needs a suitable

transplanter. Presently there are two types of transplanter viz., manually operated and power operated. Manually operated (stroke type) transplanter (CRRRI, Cuttok and CIAE Design) requires mat type of nursery. The acceptability of stroke type transplanter is dogged by its unsatisfactory performance. Whereas, despite of satisfactory performance of power operated transplanters, their suitability is limited to big size plots with plain topography. Hence, power operated transplanters are not suitable as such considering the undulating topography, fragmentation of land, transportation issues, economic constraints of the farmers etc. One of the promising option for paddy transplanting in hilly region like Konkan is the hand cranking type transplanter which transplants root washed seedlings which are traditionally being grown by the farmers. In the view of above it was necessary to optimize the seedling age for such type of transplanter to increase its performance.

■ METHODOLOGY

Ratnagiri-1 variety of paddy was selected with three different ages of nursery as 21, 28 and 35 DAS. The performance of manual paddy transplanter was measured with three different ages of nursery.

Selection of variety :

Paddy variety Ratnagiri-1 was used for the experiment. Seeds of this variety are thin and medium size with a test weight 1000 seeds was 10 to 15 g. Three different ages of nursery 21, 28 and 35 DAS were used for experiment.

Type of transplanter :

Two rows hand cranking manual paddy transplanter was used for transplanting paddy seedling (Table A and Fig. A.).

Table A : The detailed specifications of manual paddy transplanter (hand cranking)		
Sr. No.	Particulars	Specifications
1.	Weight, kg	18 kg
2.	Length, mm	750
3.	Width, mm	450
4.	Height, mm	900
5.	Row to row distance, mm	250
6.	Float type	Wooden
7.	Power transmission	Chain and sprocket
8.	No. of rows	2



Fig. A : Manual paddy transplanter (hand cranking)

Crop parameters :

The following crop parameters were taken.

Nursery height :

Nursery height was measured by 30 cm scale. For measurement purpose, the seedlings were uprooted randomly from different nursery locations and ten observations were noted. The height was measured from bottom of the seedlings to tip of leaf (Garg and Sharma, 1999).

Leaf stage :

Numbers of leaves of uprooted seedlings were counted. Ten observations from different locations were recorded and averaged.

Stem diameter :

Stem diameter of the seedling was measured with the help of vernier calliper. The diameter was measured at the height of 25 mm from the root to maintain uniformity in readings. Ten such readings were noted and averaged.

No. of leaves per plant :

The number of leaves per plant were counted.

Time required for uprooting nursery :

Total time required for uprooting nursery with three different ages was taken.

Field performance parameters :

The following field performance parameters were taken.

Plant to plant spacing :

Plant to plant spacing was measured with the help of 30 cm scale. Ten readings were noted from different locations of field and averaged.

Number of plants per hill :

Numbers of plants on each hill were noted from different locations of the field. Average number of plants per hill were calculated.

Number of hills per row :

Number of hills on each row were noted. Then the average hills per row were calculated.

Missing of hills :

The missing of hills per m² area were noted and averaged.

Total time required :

Total time required for operation of transplanter was the time required for separating seedlings, transplanting, turning, nursery feeding, repair and adjustment etc. The time required for the operation was noted with the stop watch.

Speed of operation :

The time required to cover 20 m distance was measured with the help of stopwatch and hence, the speed was calculated. Total five replications were taken for each set of observation and averaged.

Time required for turning :

Time required for turning of transplanter for each row was noted. Total time spent for turning was the summation of time spent for turning in each row.

Puddling index :

Soil water suspension/mixture samples were collected during last lap of puddling from different locations. Samples were collected in a measuring cylinder of volume 1000 ml. The soil suspension was allowed to settle for 48 hours and volume of soil settled was recorded. The puddling index was determined by using following formula.

$$\text{Puddling index (PI)} = \frac{V_s}{V} \quad \dots\dots\dots (1)$$

where,

V_s = Volume of soil, ml.

V = Total volume of the sample, ml.

Actual field capacity :

Actual field capacity was calculated as the area covered during transplanting per unit time. Total time was the actual time for transplanting and the time loss in turning of transplanter, feeding of nursery in tray etc. The formula for field capacity as given below.

$$\text{Actual field capacity (ha/hr)} = \frac{\text{Area covered, ha}}{\text{Total time required, hr}} \quad \dots(2)$$

Theoretical field capacity :

Theoretical field capacity was calculated as the product of speed of operation (km/h) and width of operation, (m) as given below.

$$\text{Theoretical field capacity (ha/hr)} = \frac{\text{Speed (km/hr)} \times \text{Width of implement (m)}}{10} \quad \dots(3)$$

Field efficiency :

It is the ratio of the effective field capacity and theoretical field capacity expressed in percentage. It is expressed in per cent as below.

$$\text{Field efficiency (\%)} = \frac{\text{Actual field capacity (ha/hr)}}{\text{Theoretical field capacity (ha/hr)}} \times 100$$

Field testing :

In order to optimize the age of paddy seedling, it was necessary to conduct field trials of different ages of seedlings. Total three trials were carried out at Dept. of Agronomy, DBSKKV, Dapoli. The field size was of



Fig B : Transplanting of root washed seedling using paddy transplanter (hand cranking) type

20 x 15 m, respectively. The field was prepared using rotavator. The depth of tilling was 15cm. Puddling was carried out with the help of power tiller. The average depth of puddle was 15cm. After puddling, the soil was allowed to settle for 48 hours. The transplanting was done in the settled puddled soil. The photograph of field testing with existing manual paddy transplanter (hand cranked) is shown at Fig. B.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Plant parameters :

The plant parameters noted during testing were height of seedling, number of leaves per plant, stem diameter. The result of observation as shown in Table 1.

Sr. No.	Particulars	Results
1.	Variety of paddy	Ratnagiri-1
2.	Type of nursery	Root washed
3.	Soil type of seed bed	Lateritic
4.	Age of seedlings (DAS)	21, 28 and 35
5.	Date of sowing of the nursery	14/06/2015
6.	Date of transplanting in the field	03/07/2015 10/07/2015 17/07/2015
7.	Number of leaves per seedling	
	21 (DAS)	5-7 leaves per seedling
	28 (DAS)	8 leaves per seedlings
	35 (DAS)	8-9 leaves per seedling
8.	Height of seedlings (cm)	
	21 (DAS)	20-25(22.5)
	28 (DAS)	25-30 (27.5)
	35 (DAS)	30-35 (32.5)
9.	Stem diameter (mm)	
	21 (DAS)	2.6
	28 (DAS)	2.9
	35 (DAS)	3.1

The average heights of seedlings of 21, 28 and 35 (DAS) were 22.5, 27.5 and 32.5 cm, respectively. The numbers of leaves per seedling were 5-7, 8 and 8-9, respectively. It was observed that, the nursery of 21(DAS) was with less entanglement of roots required

less time for preparation of root washed seedlings as compared with other two. The transplanting field parameters are given at Table 1.

Field parameters :

Various field parameters as, Length of field (m), Width of field (m), Area of field (m²), Puddling index (%), were measured and depicted at Table 2.

The area of the field and the puddling index were 390 m² and 76.6 per cent, respectively. The depth of water at the time of transplanting was 4 cm. Interval between puddling and transplanting was 48 h.

Sr. No.	Particulars	Results
1.	Length of field (m)	15
2.	Width of field (m)	26
3.	Area of field (m ²)	390
4.	Puddling index (%)	76.6
5.	Interval between puddling and transplanting (h)	48
6.	Depth of water at the time of transplanting (cm)	4 cm

Performance testing of the manual paddy transplanter (hand cranking) with different age groups of nursery :

The transplanting of paddy seedlings of three different ages *viz.*, 21, 28 and 35 DAS were carried out with the manual transplanter (hand cranking) in order to optimize the age of seedling. The performance parameters are given at Table 3.

From Table 3, it was clear that 21 DAS nursery required less time (25 min) for uprooting of 10 m² nursery and preparing root washed seedlings ready for transplanting as compared to that of 28 DAS (35 min) and 35 DAS (42 min) nursery. The reason was the more root growth and hence interlocking of roots as seedlings grew older. Also number of seedlings per hill in case of 35 DAS old nursery were less as compared to 21 DAS and 28 DAS old nursery, as the stem diameter of 35 DAS seedlings was more compared to that of 21 and 28 DAS nursery, causing less number of seedlings picked during transplanting.

Missing of hills were less in 21 DAS nursery as less stem diameter of the nursery causing more number of seedlings picked during transplanting. Planting depths were 4, 5, 4 cm, respectively for 21, 28 and 35 DAS old nursery. Time loss in operation was 0.10, 0.12 and 0.13 h and the field capacity were 0.020, 0.018 and 0.019 ha/

Table 3 : Performance testing of the transplanter with different ages of nursery

Sr. No.	Parameters	Age of seedling		
		21 DAS	28 DAS	35 DAS
1.	Time for uprooting and preparing nursery seedling ready for transplanting from 10 x 1 m ² area	25	35	42
2.	Missing hills/m ² (nos.)	8	10	9
3.	Operating speed (km/hr)	0.8	0.9	1.1
4.	Hill to hill spacing (cm)	15	15	15
5.	Planting depth (cm)	4	5	4
6.	No. of seedlings/ hill (nos.)	3-4	3-4	2-3
7.	Time loss in operation, h	0.10	0.12	0.13
8.	Field capacity, ha/h	0.020	0.018	0.019
9.	Field efficiency (%)	47.7	41.3	34.26
10.	No. of person required for operating machine	1	1	1
11.	No. of person required for feeding the nursery	1	1	1

h, respectively for 21, 28 and 35 DAS seedlings. The field efficiency were 47.7 per cent, 41.3 per cent and 34.26 per cent, respectively for different ages of seedlings. It was evident that the 21 DAS old paddy seedlings required minimum uprooting and preparation time with less missing hill, more field capacity and field efficiency as compared with 28 and 35 DAS paddy seedlings. Hence, 21 DAS paddy nursery was found more suitable for the manual paddy transplanter (hand cranking).

Conclusion :

The 21 (DAS) nursery required less time (25 min) for uprooting and preparing root washed seedlings as compared to that of for 28 (DAS) (35 min) and 35 (DAS) (42 min) nursery. Missing of hills were also less in 21 (DAS) nursery. The field capacity with existing manual paddy transplanter (hand cranking) was 0.020 ha/h for 21 (DAS) nursery, whereas, for 28 and 35(DAS) nursery it was found 0.018 ha/h and 0.019 ha/h, respectively. Hence, 21 (DAS) nursery was found suitable for manual paddy transplanter (hand cranking).

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