International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(3): 1381-1384

Received: 25-03-2020
Accepted: 27-04-2020

Manish Kumar
Department of Farm Machinery and Power Engineering, SVCAET & RC, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Parmanand Sahu
Department of Farm Machinery and Power Engineering, SVCAET & RC, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Phagu Ram Sahu
Department of Farm Machinery and Power Engineering, SVCAET & RC, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Manish Kumar
Department of Farm Machinery and Power Engineering, SVCAET & RC, Faculty of Agricultural Engineering, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Performance evaluation of 8-row self propelled rice transplanter for *kharif* season in *sandy loam* soil

Manish Kumar, Parmanand Sahu and Phagu Ram Sahu

DOI: https://doi.org/10.22271/chemi.2020.v8.i3s.9389

Abstract
Field experiment were conducted at Sonpur, Patan, Chhattisgarh in during *kharif* 2012 with view to performance evaluation of mechanical transplanter at farmers field. An 8-row self-propelled rice transplanter (Model 2 ZT-238-8) was used for study work on *sandy loam* soil (*Matasi*). The performance of the 8-row self propelled rice transplanter was found quite satisfactory. The field capacity, field efficiency and fuel consumption of the 8-row self propelled rice transplanter were 0.21 ha/h, 77.79% and 2.38 lit/ha, respectively. The cost of mechanical transplanting was found to be 1145 Rs/ha as compared to 6000 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 in that particular soil as compared to manual method transplanting of paddy.

Keywords: Rice transplanting, Mechanical 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. About 90 per cent of rice grown in the world is produced and consumed only in Asian countries. In India rice crop is planted in almost all the states on 43.95 Mha area. The total rice production of India was 106.5 Mt in 2013-14 (Anonymous, 2015) [1]. Paddy is largely grown traditionally by manual transplanting. The delay in transplanting directly affects the yield. Manual transplanting requires a lot of labors besides involving drudgery and is also very expensive. Scarcity of labors 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 percent of the total labor requirement of the crop (Behera *et al*., 2009) [3]. Hence, less expensive, farmer friendly and labor 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 8-row self propelled rice 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 percent 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) [2].

Material and Methods
Study the economic feasibility of 8-row self-propelled rice transplanter for transplanting of paddy. The field trials/field demonstrations were also carried out on farmers' field at village-Sonpur, block-Patan (The latitudinal parallel of 21°03' North and the longitudinal meridian of 81°53' East and is perched at an elevation of 280 meters above sea level) district-Durg, Chhattisgarh state during *Kharif* season of 2012. The soil of the experimental site was *sandy loam*. The experiment consisted of evaluation of field performance of the mechanical transplanter in comparison with manual transplanting. For this a 8-row self-propelled rice

transplanter shown in Fig.1 (Model 2 ZT-238-8) was used. The detailed technical specifications of self-propelled 8-row rice transplanter are shown in Table-1. Speed of operation, width of working, total time required to cover the area and the fuel consumption were recorded.

Fig 1: 8-row self propelled rice transplanter

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 rice transplanter for transplanting. In case of manual transplanting method, paddy nursery was raised following the recommended package of practices. Transplanting was done using 8-row self propelled rice transplanter by running length wise of the field on the puddled and leveled land with water level in the field kept up to 2-5 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 8- row rice 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 specification of 8-row self propelled rice transplanter

1.	Manufacturer's	M/s VST Agro Inputs, Mahadevapura,White-field road, Bangalore-560 048
2.	Model	Yanji Shakti 8-row self-propelled ricetransplanter; Model 2 ZT-238-8
3.	Overall dimension L x W x H (cm)	241 x 229 x 120
4.	Weight (kg)	320
5.	Power unit	2.94 KW(4HP) single cylinder air cooled diesel engine
6.	Planting speed (km/h)	1-2
7.	Road traveling speed (km/h)	8.2
8.	Number of rows	8
9.	Row spacing (cm)	23.8
10.	Distance between hill (cm)	14-17
11.	Growing density of seedlings hills/m^2	34-42
12.	No. of seedlings per hill, (adjustable)	3-8
13.	Width of seedling mat (cm)	22
14.	Planting depth, (cm, adjustable)	2-6
15.	Capacity (m^2/h)	1300-2000

Theoretical field capacity

Theoreticalfield capacity of an implement is the rate of coverage that would be obtained if the machine was performing its function 100% of the time at the rated forward speed and always covered 100% of its rated width (Mehta *et al*., 2005) [8].

TFC $= \frac{W \times S}{10}$

S =Speed of travel, in km/h

W =Working width of implement, in m

TFC =Theoretical field capacity, in ha/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 $= \frac{A}{T_P - T_n}$

EFC = Effective field capacity, in ha/h

Where,

EFC= Effective field capacity, ha/h

A= Total transplanted area, ha

T_P= Total operating time required for transplanting, h

Tn= 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].

$\eta = \frac{EFC}{TFC} x100$

Where,

η = Field efficiency, in %

EFC = Effective field capacity, in ha/h

TFC = Theoretical field capacity, in 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].

$$F = \frac{F_t}{T}$$

Where,

F= Fuel consumption rate, l/h

F_t= Fuel used during operation, l

T= Total time needed for operation, h

Percentage of missed hill

Number of plants missed per m^2 was counted randomly selected 1 m^2 area at 5 different places of experimental field. Average of number of plants missed per sq. m was evaluated (Patil *et al*., 2017) [10].

$$\text{Missing hills, \%} = \frac{\text{No.of plants missed per m2}}{\text{Theoritical no.of plants per m2}}$$

Percentage of floating seedling hills

Floating hills are those hills which were float after transplanting. Number of plants floated per m^2 was counted randomly selected 1 m^2 area at 5 different places of experimental field. Average of number of plants floated per sq. m was evaluated (Patil *et al*., 2017) [10].

$$\text{Floating hills, \%} = \frac{\text{No.of plants floated per m2}}{\text{Theoritical no.of plants per m2}}$$

Percentage of damaged seedling hills:

The damage hills are those hills which are physically damage at the time of transplanting. Number of plants damaged per m^2 was counted randomly selected 1 m^2 area at 5 different places of experimental field. Average of number of plants damaged per m^2 was evaluated (Patil *et al*., 2017) [10].

$$\text{Damage hills, \%} = \frac{\text{No.of plants damage per m2}}{\text{Theoritical no.of plants per m2}}$$

Cost Economics

The economic analysis of self-propelled rice transplanter was calculated according to (Kamboj *et al*., 2012) [9].

A. Fixed cost

a) Depreciation, Rs/h

$$D = \frac{C - S}{L \times H}$$

b) Interest, Rs/h

$$I = \frac{C + S}{2} \times \frac{i}{H}$$

c) Insurance, tax and housing cost Rs/h : 3% of purchase price

B. Variable cost

a) Repair and maintenance, Rs/h : 2.5% of purchase price

b) Fuel cost, Rs/h : Fuel price (Rs/l) × Fuel consumption (l/h)

c) Lubricants cost, Rs/h: 30% of fuel cost

d) Operator or labour cost, Rs/h: Number of day × Operator charges (Rs/day)

C. Total operating cost, Rs/h

Total fixed cost + Total variable cost

Where, C the initial cost of the machine, Rs; S, salvage value, @10% of C; L, life of the machine, year; H, annual use, Hour and I, interest rate. The cost economics of self-propelled was estimated by the following assumptions shown in Table: 2.

Table 2: Assumptions of self-propelled for cost economics

Total initial cost (Rs.)	1,82,000
Expected life of machine (year)	10
Annually use of machine (days)	30
Fuel cost (Rs.)	80
Operating cost (Rs.)	300

Results and discussion

The field performances of 8-row self-propelled rice transplanter for mechanical rice transplanting shown in Table: 3. Speed of transplanter was found as 1.433 km/hr, fuel consumption was 0.522 liter per hour and 2.38 liters per hectare of area transplanted. The actual field capacity and the theoretical field capacity were obtained as 0.21 ha/hr and 0.27 ha/hr respectively. The field efficiency was 77.79%. Percentage of damage hills and the percent of missing hills were 0.31% and 4.68% respectively. There was 0.62% floating hills for mechanical transplanting method. Percentage of damaged hill and missing hill were due to turning of the transplanter and hill density was 32hill/m^2 and the number of seedling per hill was 3-4.

Table: 3 Operational performance of the self-propelled rice transplanter

Sl. No	Parameters	Kharif, 2012
a)	Variety of rice	MTU-1010
b)	Date of transplanting	10-7-2012
c)	Total study area, (ha)	0.8
d)	Seed rate obtained in field, (kg/ha)	49
e)	Speed of operation, (km/h)	1.433
f)	Actual field capacity, (ha/h)	0.21
g)	Theoretical field capacity, (ha/h)	0.27
h)	Field efficiency (%)	77.79
i)	Depth of seedlings transplanted, (cm)	2.5-3
j)	Number of seedlings/hill	3-4
k)	Width covered, (cm)	190.4
l)	Labour requirement, (man-days/ha)	6
m)	Fuel consumption, (l/h)	0.522
n)	Hill to hill spacing, (cm)	
1.	Hill to hill, (assumed)	17
2.	Hill to hill, (obtained in the field)	16.5
o)	Row to row spacing, (cm)	23.8
p)	No. of hills per m^2	32
q)	Drive wheel slip, (%)	9.16

The economics of the mechanical rice transplanting and manually rice transplanting was calculated. The manual rice transplanting method is taken 240 h for covering the area of one hectare as compared to the self-propelled is taken 4.76 h. The labour charge for transplanting has Rs. 200 per day and driver charges Rs. 300 per day was taken. The variable cost and fixed cost are shown in Table: 4.

Table 4: Cost economics of mechanical and manual rice transplanting

Particular	By Self-propelled (Rs)	By manually (Rs)
Fixed Cost	133	-
Variable Cost	108	25
Total Cost per hour	241	25
Total Cost per hectare	1145	6000

References

1. Anonymous. Final estimates of area, production & productivity of principal crops during 2013-14 in M.S., 2015. http://www.mahaagri.gov.in
2. Behera BK, Varshney BP. Studies on optimization of puddled soil characteristics for self-propelled rice transplanter. AMA, 2003; 34(3):12-16.
3. Behera BK, Varshney BP, Goel AK. Effect of puddling on puddled soil characteristics and performance of self-propelled transplanter in rice crop. Int. J Agric. Eng. 2009; 10(5):1-18.
4. Behera BK, Varshney BP, Swain S. Influence of seedling mat characteristics on the performance of self-propelled rice transplanter, Agric. Engg. Today. 2007; 31(1):1-6.
5. Murali M, Anantachar M and Devojee B. Performance evaluation of four row self propelled paddy transplanter for black cotton soil**.** Journal of Pharmacognosy and Phytochemistry. 2019; 8(2):452-454.
6. Chaudhary VP, Varshney BP, Kalra MS. Self-Propelled Rice Transplanter-a Better Alternative than Manual Transplanting, Agricultural Engineering Today. 2005; 29:32-37.
7. Chaudhary VP, Varshney BP. Influence of seedling mat characteristics and machine parameters on performance of self-propelled rice transplanter. AMA, 2003; 34(2):13-18.
8. Mehta ML, Verma SR, Mishra SR, Sharma VK. Testing and evaluation of agricultural machinery. Daya publishing house, New Delhi, India, 2005, 133.
9. Kamboj, Parminder, Khurana R, Dixit A. "Farm Machinery Services Provided by Selected Cooperative Societies." Agricultural Engineering International: CIGR Journal. 2012; 14(4):123-33.
10. Patil SB, Shahare PU, Aware VV. Field Testing of Power Operated Paddy Transplanter Suitable for Root Washed Seedlings, Int. J Pure App. Biosci. 2017; 5(6):1146-1152. doi: http://dx.doi.org/10.18782/2320-7051.6011.