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Yield Attributes and Economics of Machine Transplanted Rice

S. Sreenivasulu* and P. Bala Hussain Reddy
RASS-Krishi Vigyan Kendra,
Tirupati, Andhra Pradesh.

On farm trials were conducted in five locations for three consecutive years 2009, 2010 and 2011 to assess the performance of Yanji rice transplanter for mechanical transplanting by RASS – Krishi Vigyan Kendra. The field capacity of Yanji rice transplanter was 0.16 ha per hour and time taken to cover one hectare area was 6 hours and 25 minutes. Number of productive tillers per hill^{-1}, panicle length, number of grains panicle^{-1} and yield were higher in mechanical transplanting than manual transplanting. Mechanical transplanting gave more net returns ha^{-1} (9334) with less cost of cultivation compared to manual transplanting.

Key words: Yanji rice transplanter, mechanical transplanting, Grain yield, net returns, test weight,

Rice is the major cereal crop and it plays a vital role in food security in India and grown in an area of 43.97 m. ha with a production of 104.3 m t (www. indiastat.com). In Andhra Pradesh, it is grown in an area of 29.22 lakh ha during *kharif* with a production of 75.1 lakh tonnes and an average productivity of 2570 kg ha^{-1} (www.indiastat.com). Manual transplanting is the most popular method of rice cultivation. Though, transplanting is an effective means of rice cultivation, it is tedious, laborious and time consuming shortage and high cost of labour during peak periods of agricultural operations, which results in increased cost of transplanting and delayed transplanting Further, it is very difficult to cover larger area within a short span by using manual labour. Delay in transplanting from normal date causes considerable reduction in rice yield (Safdar *et al.*, 2008). Under such situation, a less expensive and labour saving method of rice transplanting without reduction in grain yield is the need of the hour. Mechanical rice transplanting is an alternatlve option, as it requires less labour, ensures timely transplanting and also contributes to higher grain yield. Singh *et al.* (1985) reported that transplanting takes about 250 -300 man hours per ha which is 25 per cent of the total labour requirement of the crop. In this context, Rasthriya Seva Samithi – Krishi Vigyan Kendra (RASS-KVK), Tirupati introduced VST Shakti Yanji Rice Transplanter in Chittoor district during 2009 and assessed its performance for yield and economics.

Materials and Methods

The performance of Yanji rice transplanter was evaluated in five locations for three consecutive years during 2009, 2010 and 2011 in Yerpedu mandal of Chittoor district which is geographically located at 13.6°N and 79.6°E. The soil texture of the experimental field was sandy clay loam with soil pH ranging from neutral to slightly alkaline (7.1 - 8.2), electrical conductivity is normal (0.2 – 0.9 m mhos cm^{-1}), low in available nitrogen (212 - 255 kg ha^{-1}), high in available phosphorus (88 – 145 kg ha^{-1}) and medium to high in potassium (195 – 355 kg ha^{-1}).

BPT-5204, a fine grain quality was used during 2009 and ADT-37, a short duration, blast resistant and coarse grain quality suitable for parboiled rice was used during 2010 and 2011. The Yanji rice transplanter was purchased from VST Tillers and Tractors Private Limited, Bangalore with the financial support of Agricultural Technology Management Agency (ATMA), Chittoor.

In mechanized transplanting, seedlings were raised by dapog or mat method of nursery. Raised beds of 10 m length, 1.2 m width and 2.5 cm height were prepared and covered with polythene sheet of 1.2 m width and 50 micron thickness. On the plastic sheet, 21x50 cm size iron frames were placed to get the uniform size of nursery mats which is suitable to feed in to the transplanter for easy planting. These frames were filled with softened wet soil, which was sieved and mixed with well decomposed farm yard manure for better growth. Sprouted Paddy seed were spread uniformly on the wet soil and covered with paddy straw. The seed rate used was 45 Kg ha^{-1}. These nursery beds were watered using rose cans for 4-5 days and thereafter, the paddy straw was removed and seedlings were grown normally by regular watering. Seedlings were ready for transplanting by 16 to 18 days after sowing, when the height of the plant reached 10-15 cm with 3-4 leaves. Yanji rice transplanter was used for mechanical transplanting. The specifications of the transplanter are given in Table 1. After land preparation and levelling in main field, the field was allowed for sedimentation for 12 hours to avoid sinking of transplanter. The machine covered 8 rows with spacing of 23.8 cm between the rows and 17 cm between the hills in a row. Paddy nursery was raised by adopting the package of practices recommended for manual transplanting.

Corresponding author email: nivassakamuri@rediffmail.com

Results and Discussion

Yanji rice transplanter

The number of seedlings transplanted hill^{-1} was 4-6 and the depth of seedlings planted was about 5 cm in case of mechanical transplanting. The field capacity of Yanji rice transplanter was 0.16 ha hour^{-1} and the time taken to cover one hectare area was 6.25 hours.

Table 1. Specifications of VST Shakti Yanji Rice Transplanter

Engine model	170 F single cylinder air cooled diesel
Rated power	2.94 Kw
Rated speed	2600 rpm
Weight	305 Kg
Over all dimensions (L X WXH)	2500 X 2131 X 1300 mm
Row number	8
Row spacing	23.8 cm
Distance between hills	14-17cm (standard), 10-12, 12-14, 17-20, 20-23 cm (optional)
Planting speed	0.44-0.54 m / second
Road travelling speed	8.2 Km / hour
Travelling mechanism	
Type	Single wheel driven - steel wheel in paddy fields or rubber tyre on land
Planting mechanism	
Type	Separate crank shaft and connecting rod system with seedling pusher
Growing density of seedlings	32-44 seedlings / m_2
Number of seedlings hill^{-1}	3-8 (adjustable according to density and thickness of seedlings)
Width of seedling mat	22.0 cm
Planting depth	6 cm (adjustable)
Capacity	1300-2000 m_2 / hour

Yield attributes

The data from Table 2 indicated that productive tillers hill^{-1}, panicle length and number of grains panicle^{-1} were not significant between manual and machine transplanting, However, higher yield attributes were recorded with machine transplanting over manual transplanting during three consecutive years in both the varieties. This might be due to maintenance of optimum plant population and depth of planting which resulted in increased number of productive tillers hill^{-1} due to efficient utilization of growth resources. Increased number of panicles hill^{-1} and fertile grains panicle^{-1} in machine planting were also reported by Sheeja *et al.* (2012). There was no significant difference in test weight between mechanical and manual transplanting methods in both the rice varieties. Similar findings were reported by Manjunatha *et al.* (2009).

Table 2. Yield attributes as influenced by manual transplanting and rice transplanter

Year	Method of trans planting	Variety	Plant height (cm)	No. of pro ductive tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	Test weight (g)
2009	Manual	BPT-5204	71.6	15.4	17.4	124	14.2
	Trans planter	BPT-5204	81.5	17.0	20.8	139	14.9
	CD (p=0.05)		NS	NS	NS	NS	NS	NS
2010	Manual	ADT-37	63.4	14.4	16.1	113	22.4
	Trans planter	ADT-37	67.0	15.6	17.4	124	22.7
2011	Manual	ADT-37	62.8	13.3	15.3	108	22.2
	Trans planter	ADT-37	66.4	14.4	16.0	119	22.5
Mean	Manual	ADT-37	63.1	13.8	15.7	111	22.3
	Trans planter	ADT-37	66.7	15.0	16.7	122	22.6
	CD (p=0.05)	--	NS	NS	NS	NS	NS
	SE m±		1.028	0.387	0.327	4.079	0.256

The yield data (Table 3) revealed that there was no significant difference due to transplanting with rice transplanter and manual transplanting. However transplanting with mechanical transplanter recorded higher grain yield (6615 Kg ha^{-1}) than manual transplanting (5930 Kg ha^{-1}). Mechanical transplanting recorded about 10 per cent and 11 per cent increased grain yield over manual transplanting in ADT-37 and BPT-5204, respectively. It might be due to use of younger seedlings for transplanting and higher number of productive tillers hill^{-1} which in turn increased the number of filled grains panicle^{-1} due to better source-sink relations in machine transplanted rice. Similar results were also reported by Vijay Kumar *et al*., (2012) and Sheeja *et al*., (2013).

Table 3. Yield and economics of manual transplanting and transplanting with rice transplanter

Year	Method of transplanting	Variety	Grain yield (Kg ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Benefit cost ratio
2009	Manual	BPT-5204	6713	26708	67130	40422	2.51
	Transplanter	BPT-5204	7565	23183	75650	52467	3.26
	CD (p=0.05)	NS	NS	NS	NS	NS	NS
2010	Manual	ADT-37	6019	28875	64203	35328	2.22
	Transplanter	ADT-37	6657	27450	71008	43558	2.59
2011	Manual	ADT-37	5840	32538	54507	21969	1.68
	Transplanter	ADT-37	6572	28913	61320	32407	2.12
Mean	Manual	ADT-37	5930	30707	59355	28649	1.95
	Transplanter	ADT-37	6615	28182	66164	37983	2.36
	CD (p=0.05)SE m ±	--	NS182.424	NS1810.632	NS2398.436	NS641.742	NS0.106

` 1000/- (2009), ` 1066/- (2010), ` 933/- per quintal of grain

Economics

The study showed that the average cost of cultivation in machine transplanting was reduced by Rs. 2525 ha^{-1} compared to manual transplanting. It was due to more cost involved in field preparation for nursery raising, pulling of seedlings, transport of seedlings and transplanting. By using transplanter an additional benefit of 9334/- was obtained compared to manual transplanting. This was due to lower cost of labour for nursery and transplanting in mechanical transplanting. Similarly, the highest benefit cost ratio (2.36) was obtained with mechanical transplanting whereas manual method of transplanting recorded lower benefit cost ratio (1.95) . Sajitha Rani and Jayakiran (2010) also reported higher benefit cost ratio in mechanical transplanting.

Transplanting of rice with Yanji rice transplanter resulted in more number of productive tillers hill-1, panicle length, number of grains panicle-1, grain yield, net returns and benefit cost ratio compared to manual transplanting even though statistically not significant. Cost of cultivation was reduced by 9334 ha^{-1} in machine transplanted rice than manual transplanting.

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