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Studies on Mechanized Rice Transplanting and SRI Method of Rice Cultivation

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Abstract

SRI has reached certain level of acceptance among the research and scientific community in major rice producing countries. The SRI method of rice cultivation involves planting single seedling in wider row spacing ie, 25x 25 cm, which involves more labour intensive and laborious process. Hence, the present study was conducted with an objective to compare the mechanized rice transplanting method with SRI method of cultivation. The study was conducted with four treatments *viz.*, T_1- Planting with transplanter + SRI principles, T_2- Planting with manual labour (25 cm x 25 cm) + SRI principles, T_3- Conventional transplanting (20 cm x 10 cm), T_4- Farmers practices. The study indicated that mechanized transplanting with rice transplanter adopting 30 x 14 cm row spacing recorded more 10.00 per cent more yield when compared to SRI method of planting (25 x 25 cm spacing) with the high cost benefit ratio of 2.72.

Key words: Mechanical rice transplanter, SRI, panicle weight, benefit cost ratio

Introduction

Rice is one of the most important cereals that holds the key for food security. In India, rice is presently grown in an area of 43.42 m. ha. with a production of about 98.95 m.t (Anonymous, 2014). At the current rate of population growth, the country has to produce about 120 m. t. of rice by 2030 to feed the ever growing population (Anonymous, 2011). Meeting the targeted demands of rice is a challenging task for the policy makers, researcher and all other stakeholders.

The problem is still confounded as the targeted increase has to be met in the background of declining resource base especially the land, water and labour and increasing environmental concerns. Increasing water scarcity is becoming a real threat for rice cultivation. About 80 percent of fresh water is being used for agriculture and out of this more than 50 percent is consumed by the rice crop alone. It is now evident that rice crop cannot have the luxury of water that it had in the past due to acute water shortages. There are some options such as zero tillage, direct seeding, aerobic rice and the System of Rice Intensification (SRI) which can help to save water and enhance water productivity irice cultivation. However, the former methods lead to yield reduction, while SRI has the potential to enhance yield and economize the water use. SRI has reached certain level of acceptance among the research and scientific community in major rice producing countries. The SRI method of rice cultivation involves planting single seedling in wider row spacing *i.e.* 25x 25 cm, which involves more labour intensive and laborious process. Reliance on human and animal power for day to day management of farm operations is showing a continuous decline over the last few years leading to considerable progress in agriculture mechanization. Mechanical equipments for various farm operations are generally being used by the farming community. Even small farmers are adopting and utilising selected farm equipments for efficient farm management through custom hiring. Transplanting, weeding and harvesting are the major operations that consume most of the labour requirement in rice cultivation. Mechanization with SRI methods leads to maintain plant-to-plant spacing and reducing seedling age, reducing the seed requirements by 50%, labor requirements reduction by 60%, and the time required for all of the main rice-farming activities by 70%. High labour demand during peak periods adversely affects timeliness of operation, thereby reducing the crop yield. Usage of tools, implements and machineries for puddling, transplanting, weeding and harvesting will lead to reduction in drudgery, cost and time. Hence, the present study was conducted with an objective to compare the mechanized rice transplanting method with SRI method of cultivation.

Data were collected from a representative sample of growers using Self-propelled Paddy Transplanter and manual transplanting of paddy in different villages of Trishur, Palakkad and Mallappuram districts of Kerala during the year 2009-10. The average net returns were Rs. 19,798 per ha and Rs. 27,462 per ha in traditional and self-propelled paddy transplanting methods of paddy cultivation, respectively. The yield realised in traditional method was 4.83 tha^{-1} and it was 5.70 t ha^{-1} in self-propelled paddy transplanting method. The cost of cultivation in both the methods was more or less the same (Rs. 30,387 ha^{-1} in traditional method and Rs. 31,750 in self-propelled paddy transplanting). The benefit cost ratio was 1.87 in self-propelled paddy transplanting technology as compared to 1.65 in manual transplanting (Singh and Rao, 2012).

Mohanty *et al*. (2010) conducted a study at farmer's field by Krishi Vigyan Kendra, Deogarh, Odisha state during 2009 on the feasibility of mechanizing transplanting operations of paddy crop with a view to reduce the cost of cultivation. A plant population of 34-36 hills m^{-2} was achieved by the transplanter. Number of plants per hill was observed to be with in 3 to 5. An eight row self-propelled paddy transplanter was used for the purpose. The performance of the mechanical transplanter was quite satisfactory. The field capacity, field efficiency and fuel consumption of the transplanter were 0.123 ha h^{-1}, 78 per cent and 6.5 l ha^{-1}, respectively. Cost of mechanical transplanting was Rs.1554 ha^{-1} as compared to Rs. 2675 ha^{-1} in case of manual transplanting. Grain yield in both manual and mechanical transplanting remained on par with mean grain yield of 41.4 and 34.8 q ha^{-1}, respectively. The missing hill percentage was less than 10 per cent.

The impacts of the system of rice intensification (SRI) and conventional management (CM) on grain yield, yield components and tillering capacity were examined under 4 rice establishment methods transplanting (TP), seedling casting (SC), mechanical transplanting (MT) and direct seeding (DS) (Song Chen *et al*., 2013). SRI produced significantly higher grain yield than CM under TP and MT but not under DS or SC. DS and SC produced much higher seedling quality than TP or MT, suggesting that robust seedlings with vigorous roots weaken the positive effect of SRI on rice yield. SRI produced a higher tillering rate than CM, but did not affect ear-bearing tiller rate significantly. Moreover, the net photosynthetic rate of the recent fully expanded leaf at mid-tillering stage was significantly higher in SRI than in CM under MT and TP.

A field experiment was conducted during March -June 2008 at wet land in Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu to optimize the spacing and depth of transplanting in rice cultivation using self propelled rice transplanter (Yanmar 6 row) (Duraisamy *et al*., 2011). Higher DMP (24231 kg ha-^{1}), root length (16.63 cm), number of panicle m^{-2} (862 Nos.m^{-2}) and grain yield (7167 kg ha-^{1}) was produced when transplanting was done at 30 x 22 cm spacing (15 hills m^{-2}). Among the depth of planting, increased plant dry matter production (17498 kg ha-^{1}), root length (17.28 cm), number of panicle m^{-2} (812 Nos.m^{-2}), filled grains panicle^{1} (113 Nos.) panicle length (22 cm) and grain yield (7667 kg ha-^{1}) was produced in 4 cm depth. Veeramani *et al*. (2012) reported that tiller production could be optimized by transplanting seedlings at younger ages compared to modified rice mat nursery. The maximum number of tillers produced by the rice plant is inversely proportional to the length of the phyllochron.

Materials and Methods

A trial was conducted during *Rabi* 2012, at Department of rice fields, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu by comparing four treatments detailed below with the variety CO (R) 50.

T_1- Planting with transplanter (30 x 14 cm) + SRI principles

T_2- Planting with manual labour (25 cm x 25 cm) + SRI principles

T_3- Conventional transplanting (20 cm x 10 cm)

T_4- Farmers practices (Random planting)

Nursery for machine planting was raised in trays. The trays were filled with media consisted of mixture of decomposed coir pith, farmyard manure and well sieved field soil. A seed rate of 75 g/tray was used. Fourteen days old seedlings were planted at a spacing of 30 x 14 cm using four row walk behind self propelled rice transplanter (Kukje). Other management practices like weeding, fertilization and irrigation was done as per the standard procedure followed for SRI techniques.

In SRI method the nursery was raised in raised bed and fourteen days old seedlings were planted at a spacing of 25 x 25 cm. In conventional method the nursery was raised and 22 days old seedlings were planted at a spacing of 20 x 10 cm. In farmers method nursery was raised and 22 days old seedlings were planted randomly with manual labours. The recommended package of practices was followed as per the treatments. The operational view of rice transplanter is shown in Fig.1 and the transplanted field is shown in Fig. 2.

Fig. 2. Mechanical rice transplanted field

Cost of cultivation for each treatments were calculated by taking considerations of all inputs and labour cost based on the requirements of the each treatment and cost benefit ratio was calculated. The data recorded were statistically analysed.

Fig. 1. Self propelled walk behind rice transplanter (kukje) in operation

Results and Discussion

Grain yields were significantly higher under all the treatment when compared to the farmers practice, with average yields that were 44.56 per cent higher for Mechanical transplanting with SRI principles , 31.83 per cent higher for SRI planting with manual labour and 18.35 per cent higher for manual transplanting by recommended spacing of 20 x 10 cm. The greatest yield of 7.72 t ha^{-1} was found in Mechanical transplanting with SRI principles (Table 1). There was about 10.00 per cent increase in grain yield of mechanized transplanting over SRI practice. There was no significant difference in panicle number per m^2 between mechanical transplanting with SRI principles and SRI planting with manual labour. Significant increase in panicle number per m^2 was found in between farmers practice to Mechanical transplanting with SRI principles and SRI planting with manual labour. The positive effect of SRI system has been well documented by Song Chen *et al*. (2013). In the current study, similar results were found in the Mechanical transplanting with SRI principles. The response of yield components to SRI also indicated that the increased grain yield using the SRI system with mechanical transplanting methods might be attributed to the improved number of panicle and panicle weight. Our results indicate that SRI might play an important role in single panicle development in mechanical transplanting, which provided evidence for the importance of a strong individual tiller. It also found that promoting early tiller emergence as a response to transplanting young seedlings increased grain yield. This might partly explain the yield increase in SRI treatment in the mechanical transplanting and manual transplanting systems.

The results revealed that the higher yield under mechanized planting was attributed to adoption of required plant population with wider spacing resulted in more number of productive tillers and panicle weight. The cost of cultivation under mechanized planting was also considerably less (Rs. 28600 ha^{-1}) as compared to SRI practice (Rs. 29357 ha^{-1}). The Benefit cost ratio was higher with machine transplanting (2.72) as compared to SRI practice (2.40) conventional method (2.05) farmers method of random planting (1.59).

Conclusion

The study indicated that mechanized transplanting with rice transplanter adopting 30 x 14 cm row spacing with SRI principles recorded 10.00 per cent more yield when compared to SRI method of manual planting (25 x 25 cm spacing) and 44.56 per cent higher yield than farmers practice with the high cost benefit ratio of 2.7

References

Anonymous. 2011. Vision 2030. Published by ICAR, Central Rice Research Institute, Cuttack, India

Anonymous. 2014. Agricultural Statistics at a Glance, 2014, Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India (Website: http://www.dacnet.nic.in/eands).

Duraisamy VM, T Sentilkumar and S Subbulaksmi. 2011. Studies on standardisation of spacing and transplanting depth for a self propelled rice transplanter. *Agricultural Mechanization in Asia, Africa, and Latin America* 42 (1): 42-44.

Mohanty DK, KC Bari and MK Mohanty. 2010. Comparative performance of eight row self - propelled rice transplanter and manual transplanting at farmer's field. *Agricultural Engineering Today* 34(4):15-17.

Singh RS and KVR Rao. 2012. Impact of self propelled paddy transplanter in kerala. Book chapter in Rural Development. International Conference of Agricultural Engineering - CIGR-AgEng 2012: agriculture and engineering for a healthier life, Valencia, Spain, 8-12 July 2012 pp. C-1698.

Song Chen, Xi Zheng, Dangying Wang, Chunmei Xu and Xiufu Zhang. 2013. Influence of the improved system of rice intensification (SRI) on rice yield, yield components and tillering characteristics under different rice establishment methods. *Plant Production Science* 16(2): 191—198.

Veeramani P, R Durai Singh and K.Subrahmaniyan. 2012. Study of phyllochron - System of Rice Intensification (SRI) technique. *Agricultural Science Research Journal* 2(6): 329-334.

Table 1: Comparative performance of Machine planting, SRI method, conventional and farmers practice on yield parameters, grain yield of rice and B:C ratio

Treatments	Panicle no./m^2	Panicle weight (g)	Grain yield (t ha^{-1})	Percent increase in grain yield over farmers practice	Cost of Cultivation (Rs ha^{-1})	B:C ratio
Transplanter + SRI principles	447[c]	2.97[c]	7.72[d]	44.56	28600	2.72
Planting with manual labour (25 cm x 25 cm) + SRI principles	436[c]	2.87[c]	7.04[c]	31.83	29357	2.40
Conventional transplanting (20 cm x 10 cm)	416[b]	2.72[b]	6.32[b]	18.35	30783	2.05
Farmers practice	362[a]	2.32[a]	5.34[a]		32530	1.59
CD (0.05)	20	0.14	0.36			