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Studies on Standardisation of Spacing and Transplanting Depth for a Self Propelled Rice Transplanter

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Abstract

A field experiment was conducted during March-June 2008 at wetland in Tamil Nadu Agricultural University to optimize the spacing and depth of transplanting in rice cultivation using a self propelled rice transplanter (Yanmar 6 row). The treatment consisted of 4 levels of hill spacing (30 × 32 cm, 30 × 22 cm, 30 × 18 cm and 30 × 16 cm) in the main plot and depth of planting (manual, 2 cm and 4 cm depth) in the sub plot. Higher DMP (24,231 kg ha^{-1}), root length (16.63 cm), number of panicles m^{-2} (862 m^{-2}) and grain yield (7,167 kg ha^{-1}) were produced when transplanting was done at 30 × 22 cm spacing (15 hills m^{-2}). Among the depth of planting, increased plant dry matter production (17,498 kg ha^{-1}), root length (17.28 cm), number of panicles m^{-2} (812 Nos. m^{-2}), filled grains paniclel (113), panicle length (22 cm) and grain yield (7,667 kg ha^{-1}) were produced in 4 cm depth.

Introduction

Food security to the people is the key issue pressing the scientists, bureaucrats and politicians around the world. Among the food grains, rice is one of the important stable foods for the world population. Almost 90 % of the world's rice is produced in Asia. In India, rice is the major crop and occupies the largest cropped area of 44.2 Mha with a total production of 87.5 Mt and an average productivity of 1.9 t ha^{-1} (Natarajan *et al.*, 2008). To meet the growing demand required for the population, the rice yield has to be doubled. SRI is a method of cultivation in which higher yields are obtained with less seed, less water and judicial application of fertilizer.

In all rice growing regions of the country, there is acute shortage of human labour during the rice transplanting period and in many cases this delays transplanting, leading to reduced yield and less profit. So, transplanting by labour is becoming difficult in terms of economics, though it is the effective means of rice cultivation. In the SRI method of cultivation, manually marking of the plot is done before transplanting to ensure proper spacing. Then labourers transplant one or two young rice seedling in each grid of the marking. This method of planting requires careful planting on the grid which is difficult for the workers who do not normally follow proper spacing in planting and maintain seedling population per hill. Moreover, in the conventional method of planting, 25-30 day old seedlings are transplanted, whereas, in the SRI method of transplanting, 15 day old seedlings are transplanted (Berkelaar, 2001; Willem and Kassam, 2006).

Mechanization has become a necessity to reduce drudgery in farm operations including women farm workers. In order to overcome difficulties faced by the workers in transplanting the seedling, it is felt that a rice transplanter should be developed for rice planting. In India various types of rice transplanters (imported from eastern countries, viz. Japan, Korea, China, etc.) are used by the farmers. Spacing is very important for optimum plant population per unit area and will be reflected on the yield of the crop. Depth of planting is very crucial for getting uniform establishment. The correct planting depth is one that places the seed where it can imbibe water for germination but not desiccate thereafter. In the SRI techniques 12-15 day old seedlings are transplanted and mechanical weeding is done 10 days after transplanting. It is often necessary to plant deeper to protect from mechanical damage. But. it should be standardized for getting higher yield. Hence, a field study was conducted to standardize the spacing and depth of planting with a self propelled six row Yanmar transplanter.

Materials and Methods

A field experiment was conducted at wetland in Tamil Nadu Agricultural University during March-June 2008 with medium duration rice cultivar ADT 43 to optimize the spacing and depth of planting with a self propelled six row Yanmar rice transplanter. The experiment was laid out in a split plot design and replicated thrice. The main plot was comprised of 4 levels of plant spacing (30 × 32 cm, 30 × 22 cm, 30 × 18 cm and 30 × 16 cm) and sub plots comprised of depth of planting (manual, 2 cm and 4 cm). Rice seedlings of 15 days old were used for transplanting. Other management practices like weeding, fertilization and irrigation were done according to standard procedure followed for SRI techniques.

Results and Discussion

Effect of Treatment on Growth Attributes

Transplanting younger seedlings at an optimum spacing facilitates use of mechanical weeding and permits greater root growth, better tillering and provides other favourable conditions for better growth, especially soil aeration (Kumar and Shivay, 2004). Significantly higher DMP (Dry Matter Production) was produced by a wider spacing of 30 × 22 cm. DMP at harvest was 32.72 and 48 % higher in 30 × 22 cm spacing (**Table 1**) over 30 × 32 cm spacing and 30 × 16 cm spacing due to the obvious reasons of optimum plant population, better land area and availability of nutrients, water and energy. Koma and Sinv (2003) opined that with more resources available to the plants, more tillers were produced with more growth above the ground for effective photosynthesis. Wider spacing (15 hills m^{-2}) enabled plants to receive radiation twice that of densely spaced ones. Light reached even lower leaves, which also contributed to production of assimilates for plant growth and development (Mahender Kumar, *et al.*, 2007).

Depth of planting is very crucial for getting uniform establishment. The correct planting depth is one that places the seed where it can imbibe water for germination but not desiccate thereafter. In the SRI techniques, 12-15 day old seedlings were transplanted and mechanical weeding was done at 10 days after transplanting. It was often necessary to plant deeper to protect from mechanical damage. Higher DMP of 17,498 kg ha^{-1} was produced by 4 cm compared to 2 cm depth of planting due to roots that had strong anchor-

Table 1 Effect of spacing and depth of planting on growth, yield attributes and yield of rice

Treatments	DMP (kg ha^{-1})	Root length (cm)	Number of panicles (Nos. m^{-2})	Filled grain $panicle^{-1}$ (Nos.)	Panicle length (cm)	Grain yield (kg ha^{-1})
Spacing						
30 × 32 (10 hills m^{-2})	6,301	15.20	635	93	20	6,287
30 × 22 (15 hills m^{-2})	24,231	16.63	862	99	20	7,167
30 × 18 (18 hills m^{-2})	15,114	15.57	783	98	21	6,930
30 × 16 (21 hills m^{-2})	20,699	15.62	635	119	24	6,283
S.Ed.	510.29	0.62	20.23	3.37	1.06	205.54
CD (0.05)	1,029.72	1.28	41.02	6.91	2.16	415.22
Depth of planting						
Manual	15,124	13.94	658	89	20	5,635
2 cm depth	17,136	16.05	716	105	21	6,697
4 cm depth	17,498	17.28	812	113	22	7,667
S. Ed.	410.99	0.73	20.96	2.54	1.02	310.13
CD (0.05)	826.91	1.47	40.29	5.16	2.04	638.44

age with soil when planting depth increased. It enabled the plants to take nutrient and water from a deeper layer. Shallow depth of planting leads to a shallow rooting pattern and also most roots are distributed in top layer, and roots become shallower with the wider spacing (Zhu Defeng *et al.*, 2002).

Root length (**Table 1**) was higher (16.63 cm) with 30 × 22 cm spacing (15 hills m^{-2}). Transplanting at a wider spacing (15 hills m^{-2}) provided ample light intensity and soil volume, which encouraged luxurious growth of roots and tillers supporting synergically. About 60 % of photosynthates formed in the shoots were translocated to roots for its growth, which pervasively explored soil for water and nutrient to supply to the aerial parts (Mahender Kumar *et al.*, 2007). Planting the seedlings at 4 cm depth produced lengthier roots of 17.28 cm than other methods of planting.

Effect of Treatment on Yield Attributes and Yield

The number of panicles m^2 (862 m^{-2}) was significantly higher in 30 × 22 cm spacing (**Table 1**). The enhanced availability of resources under wide spaced rice and optimum population per unit area could have allowed more productive tillers to be produced. The number of total tillers increased exponentially as the number of phyllochrons (leaf number) advanced (Zhu Defeng *et al.*, 2002). More total tillers ultimately produced more productive tillers. The number of filled grain panicles^{-1} (119 panicle^{-1}) and panicle length (24 cm) were significantly higher with 30 × 16 cm spacing. This was due to fewer productive tillers m^{-2} produced under this spacing and led to more allocation of source in limited sink. Enhanced root growth increased DMP and led to higher productive tillers that, ultimately, led to higher grain yield (7,167 kg ha^{-1}) under 30 × 22 cm spacing.

More panicles m^{-2} (812 m^{-2}), filled grain panicles^{-1} (113 panicle^{-1}) and grain yield (7,667 kg ha^{-1}) was higher when seedlings were planted at 4 cm depth. Better root growth and shoot growth under this treatment ultimately led to higher yield attributes and crop yield. Incorporation of farm yard manure, green manure and green leaf manure should be done at 5 cm depth. When seedlings were planted at the 4 cm depth, roots could get nutrients easily with less energy. This resulted in better shoot and root growth.

Conclusion

In the SRI techniques 12-15 day old seedlings were transplanted and mechanical weeding was done at 10 days after transplanting. So, seedlings were at very young stage. It was often necessary to plant deeper to protect from mechanical damage by a weeder. So, transplanting the seedling at optimum spacing of 30 × 22 cm (15 hills m^{-2}) and at 4 cm depth was the ideal spacing and depth for higher yield under the SRI with transplanter.

REFERENCES

Berkelaar, D. 2001. SRI, the system of rice intensification: less can be more. EDN#70

Koma, Y. S. and S. Sinv. 2003. An assessment of ecological system of rice intensification (SRI) in combodian wet season. CEDAC field document, Phnom Rentil CEDAC mimeo.

Kumar, D. and V. S. Shivay. 2004. System of rice intensification. Indian Farming, 54(8): 18-21

Mahender Kumar, R., K. Surekha, Ch. Padmavathi, L. V. Subba Rao, V. Ravindra Babu, S. P. Singh, S. V. Subbaiah, P. Muthuraman, and B. C. Viraktamath. 2007. Technical Bulletin on System of rice intensification—A water saving and productivity enhancing strategy in irrigated rice. Directorate of Rice Research, Rajendranagar, Hyderabad, India.

Natarajan, S., K. Kayalvizhi, M. Ganapathy, K. Arivazhagan, and P. Anandan. 2008. Agronomic evaluation of certain systems of rice cultivation in northern cauvery delta in south India. In '3rd national symposium on system of rice intensification in India. 1-3rd December, 2008. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Willem, A. S. and A. H. Kassam. 2006. System of Rice Intensification (SRI): Implication for Agronomic Research. Tropical Agriculture Association Newsletter. 26(2); 22-24.

Zhu Defeng, Cheng Shihua, Zhang Yuping, and Lin Xizquin. 2002. Tillering pattern and the contribution of tillers to grain yield with hybrid rice with wide spacing. http://ciifad.cornell.edu/sri:607-255-0831:

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