International Journal of Research in Chemistry and Environment
Vol. 2 Issue 1 January 2012(58-61)
ISSN 2248-9649

Research Paper

Studies on Different Planting Pattern (Using Rolling Marker) in System of Rice Intensification (SRI) through Hybrid Rice CORH 3

***Veeramani P., Singh Durai R., Subrahmaniyan K.**
Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, INDIA.

Available online at: www.ijrce.org

(Received 27th July 2011, Accepted 14th September 2011)

Abstract *- The System of Rice Intensification (SRI) is a new technique for rice culture. The main features of this system are: transplanting of young seedlings singly in a square pattern with wide spacing, using organic fertilizers and hand weeding, and keeping the paddy soil moist during the vegetative growth phase. Significant phenotypic changes occur in plant structure and function and in yield and yield components under SRI cultivation. The production increases can be notable. However, there are some constraints to adoption of the presently recommended set of practices, e.g., a small number of plants may not be suitable for the low solar radiation condition. In SRI cultivation, adopting proper spacing during transplanting is one of the essential principles underlying the technology. However, practical adaptability of uniform spacing becomes very tedious under field conditions and farmers find it difficult to mark the recommended spacing. With this objective, the field experiment was conducted transplanting single seedling in different patterns in main field (using rolling markers) under SRI cultivation method. The experiment was laid out in a factorial randomized block design (FRBD) replicated thrice. The following modifications were tested, in the triangular method, the seedlings are planted in a zig zag pattern with 25cm spacing between each seedling and also rows, next oblong method of planting the seedlings are planted in a oblong pattern with 25cm spacing between each seedling and 30 cm between the rows. Significant phenotypical changes occur not only in plant structure and function but also in yield and yield components under SRI cultivation. The zig zag and oblong methods of planting can be perfectly and economically taken up only by utilizing specially designed rolling markers, that had significant in increasing the number of productive tillers, minimize time and cost of transplanting in SRI. With these modifications, grain yield exceeded 10.5 t ha^{-1}, 31 % greater than in square pattern of planting. zig zag pattern of planting adopted by using triangular rolling markers was found to be the best option for getting higher productivity in hybrid rice under System of Rice Intensification technique.*

Keywords : Square, Zig zag, Oblong transplanting pattern.

Introduction

To assure food security in the rice-consuming countries of the world, those countries will have to produce 50 per cent more rice with improved quality to meet consumers demand by 2025. This additional rice will have to be produced on less land with less water, less labor, and fewer chemicals. The task becomes even more difficult when rice quality preferences gradually receive more attention. Crop improvement and management have played an important role in increasing the production of major food crops in the past. There is no doubt that the task of making gains becomes even more difficult when rice yield is already at the high level. The System of Rice Intensification (SRI), developed in Madagascar over a 20-year period and synthesized in the early 1980s [3,4], offers opportunities to researchers and farmers to expand their understanding of potentials already existing in the rice genome. Experience with SRI methods suggests that average rice yields can be about double the present world average without requiring a change in cultivar's or the use of purchased input[5]. Moreover, only about half as much water per season is required for these higher yields. Crop protection requirements are reduced because SRI plants are more resistant to damage by pests and diseases. The SRI methodology for raising rice production makes three main changes in irrigated rice cultivation: transplanting younger

seedlings, preferably 8-15 days old before the plants enter their fourth phyllochron of growth, planting the seedlings singly rather than in clumps of 3-6 plants, and keeping the paddy soil moist but not continuously saturated during the plants vegetative growth phase. In system of rice cultivation (SRI), proper spacing in the planting of seedlings is one of the essential principles.

A spacing of 25 x 25 cm in a uniform square pattern is the recommended practice. However practical adaptability of planting single seedling in square method becomes very tedious under field conditions and farmers find it difficult to mark the recommended spacing with the conventional method of using rope as marker.

This led to the development of a handy implement, the rolling marker overcoming the constraints of rope. The marker when rolled on wet paddy field makes uniform square impressions. Lately, the adoption of zig zag and oblong pattern of planting under SRI has been tried instead of square planting. Focusing these points, the present study was undertaken to evaluate the response of hybrid rice in modified mat nursery and to different planting pattern in main field (using rolling markers) under SRI principles

Material and Methods

The field experiment was conducted at Agricultural College and Research Institute, Madurai from July to November 2006. The soil type was sandy clay loam with a pH of 7.3. It was low in available N, medium in P and high in available K. The organic carbon content was 0.31 per cent. The hybrid rice CORH 3 was used, the seeds of CORH 3 were obtained from Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in a Factorial Randomized Block Design (FRBD) replicated thrice. The treatments tried were five nursery treatments *viz.*,

Nursery treatments

N_1 : Water soaked seed (24 hours) + 25 g m^{-2} powdered DAP+ 0.5% urea drenching on 9th day

N_2 : Seed fortification with 1% KCl + 6 g m^{-1} *Pseudomonas* + 50 g m^{-2} powdered DAP + 0.5% urea drenching on 9^{th} day

N_3 : Seed fortification with 1% KCl + 6 g m^{-2} *Pseudomonas* + 50 g m^{-2} VAM + 0.5 kg m^{-2} vermicompost + 0.5 % DAP drenching on 9^{th} day

N_4 : N_2 +20 g m^{-2} *Azophos* + 50 gm^{-2} VAM + 0.5 Kg m^{-2} vermicompost

N_5 : N_3 + 20 g m^{-2} *Azophos* + 50 g m^{-2} VAM + 0.5 kg m^{-2} vermicompost

Main field treatments

M_1 : Square planting (25 x 25 cm)

M_2 : Zig zag planting (25 x 25 cm)

M_3 : Oblong planting (30 x 25 cm)

Modified rice mat nursery preparation

The purpose of raising modified rice mat nursery is for easy handling of younger seedlings without any root damage and increasing the tillering in main field. Raised beds @ 20 No. ha^{-1} were formed with a dimension of 5 x 1 m with 2 cm height. Over this, polythene sheets were spread on puddled soil and enriched soil with DAP was put over the polythene sheet to a height of 2 cm. Treated and sprouted seeds were broadcast uniformly in the beds at 75 g m^{-2} on dry weight basis and then the seeds were covered with thin layer of sand. Watering was done through the shallow channel provided around the bed. Excess water was drained through the drainage channel. After sprouting of seeds, the water level was maintained just to immerse the bed. For the first three days, the beds were covered with paddy straw to maintain high humidity for uniform germination and establishment of seeds. The nursery was watered 2-3 times a day up to five days after sowing (DAS). After the 5^{th} day water was let into irrigation channel between the nursery beds to keep the beds soaked. The seedlings were maintained in the nursery beds up to 14 days from the date of sowing. (See Table 1).

Description of the technology

To practice SRI it is evitable to adopt planting of single seedling in square planting with the spacing of 25 cm x 25 cm. However planting single seedling in square method using rope becomes very tedious under field conditions and it is laborious time consuming and costly.

In order to overcome these constraints, a rolling marker was designed and developed. It is a handy implement. The marker consists of (i) A cylindrical contraption (or marker) rotating along an axial pipe (ii) A metallic handle (manually pulled) to facilitate rolling of the marker (Figure 1). The cylindrical contraption rods are welded together so as to form square, triangular and oblong impressions when rolled on wet paddy field. The handle is attached to the central axial rod for manual pulling.

An improvement over the existing square planting in SRI is the adoption of zig zag and oblong planting which still reduces the competition among the seedlings and helps in easy usage of the cono or rotary weeder. This implement is also very handy, easy to operate, does not require skilled labour and economical. However, complete puddling and perfect levelling of the field is very much required for making clear marking. Moreover the field has to be drained eight hours before transplanting.

Results and Discussion

Single plants in a square pattern with wide spacing cannot produce sufficient panicles, so the yield potential is limited. The triangular/oblong planting method development appears to be a valuable adaptation of SRI practice, increasing plant density by 50% while maintaining good plant exposure to the sun and air. It has long been known that rice plants on the edge of a field are more grain-bearing than plants in the interior. This is called 'the edge effect,' and it is too avoided when taking samples from which to estimate yield. What SRI practices aim to achieve is 'the edge effect' throughout the whole field.

Planting pattern had significant influence on growth parameters of rice. Among different planting pattern, oblong pattern (30 x 25 cm) recorded maximum plant height, leaf area index, total tillers per plant and dry matter accumulation. This is because of wider spacing which influenced the vegetative growth in a better way than

closer spacing by increasing the nutrient absorption by plants and resulted in better DMP. Increased growth of plants under wider spacing could not compensate the higher plant population per unit area under closer spacing

The zig zag planting pattern (25 x 25 cm) was better as compared to oblong pattern (30 x 25 cm). Oblong pattern of planting (30 x 25 cm) influenced significantly the yield attributes like panicle length, panicle weight, thousand grain weights and filled grains panicle^{-1}, but its wider nature of spacing reduced the plant population per unit area and yield attributes like number of panicle per unit area. Hence, it directly affected the grain and straw yield. It might be due to wider spacing with continuous availability of nutrients and better source sink relationship, which might have helped with higher carbohydrate synthesis and translocation to the yield attributing points[2]. Zig zag and oblong pattern of planting registered 10,598 kg^{-1}, 10,548 kg^{-1} and 11,935 kg ha^{-1}, 12,009 kg ha^{-1} of grain and straw yield respectively (Table 3). The zig zag and oblong planting pattern had good exposure to the sun and air. Even through the oblong pattern had attained a good result in other yield parameters, it failed to maintain plant population because of its wider spacing. Mostly this yield reduction due to less plant population in oblong pattern of planting.

Wider spacing and less plant population per unit area, resulted in increased root volume, root length and root dry weight, due to abundant availability of nutrients, light intensity and water availability. The zig zag and Oblong planting pattern appears to be a valuable adoption of SRI practice, increasing plant density by 50 per cent, while, maintaining the good plant exposure to the sun and air[1]. SRI method, rice yield was increased by 20 per cent, whereas in the modified patterns (zig zag and oblong) yield increase was still higher to about 55 per cent. (See Table 2).

Conclusion

The pattern of planting in main field, zig zag pattern (25 x 25 cm) was better as compared to oblong pattern (30 x 25 cm). Through even the oblong pattern attained a good result in other yield parameters, it failed to maintain plant population because of its wider spacing. Higher benefit cost ratio was obtained with the combination of organic, inorganic and biofertiliser treatments in nursery and zig zag pattern of planting (using rolling markers) under SRI technique. A modified-SRI according to our ecosystem can increase rice yield significantly. The modifications include changes in transplanting density, planting pattern, and field management. Based on the experimental results, it was concluded that an integrated approach of nursery treatment like seed fortification with 1% KCl + Pseudomonas 6 g m^{-2} + powdered DAP 50 g m^{-2} + 0.5% DAP drenching on 9th day + Azophos 20 g m^{-2} + VAM 50 g m^{-2} + vermicompost 0.5 kg m^{-2} and transplanting in zig zag pattern (25 x 25 cm) by marking impressions with triangular rolling marker was the best agronomic option for getting higher yield in hybrid rice under SRI technique.

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Table 1: Soil physico-chemical characteristics of the experimental field

S. No.	Characters	Values
I.	**Mechanical analysis (Piper,1966)**	
	Coarse sand	37.54 %
	Fine sand	32.42 %
	Silt	10.59 %
	Clay	19.52 %
	Texture	Sandy Clay Loam

II.	**Chemical analysis**	
	Available N [7]	241.0 Kg ha^{-1}
	Available P_2O_5 [8]	19.30 Kg ha^{-1}
	Available K_2O [9]	220.0 Kg ha^{-1}
	Organic carbon [10]	0.30 %

III.	**Physico-chemical analysis (Jackson, 1973)**	
	pH (1:2 Soil water suspension)	7.4
	EC (1:2 soil water suspension)	0.56 dSm^{-1}

Table 2: Yield response to different planting patterns (Using rolling marker) in rice

Transplanting pattern	**Yield (t ha^{-1})**	**Compared to square pattern**	
		+ t ha^{-1}	**+ %**
Square pattern	7.24		
Zig zag pattern	10.59	3.35	31.6
Oblong pattern	10.54	3.3	31.3

Table 3: Effect of yield characters due to different planting pattern using rolling markers

Treatments **Planting pattern (M)**	**Panicles (hill^{-1})**	**Panicles (m^{-2})**	**Panicle length (cm)**	**Panicle Weight (g)**	**Number of filled grains panicle^{-1}**	**Test grain weight (g)**	**Grain yield (kg ha^{-1})**	**Straw yield (kg ha^{-1})**
M_1 – Square pattern	20.6	345.9	21.4	2.48	108.1	20.56	7244	8935
M_2 – zig zag pattern	29.5	437.3	22.5	2.60	110.4	21.13	10598	11935
M_3 – Oblong pattern	34.0	451.9	23.5	2.71	113.2	21.58	10548	12009
SE_d	**0.4**	**16.3**	**0.4**	**0.02**	**0.2**	**0.06**	**99.1**	**148.3**
CD(P=0.05)	**0.9**	**33.5**	**0.4**	**0.04**	**0.4**	**0.13**	**203.1**	**303.8**

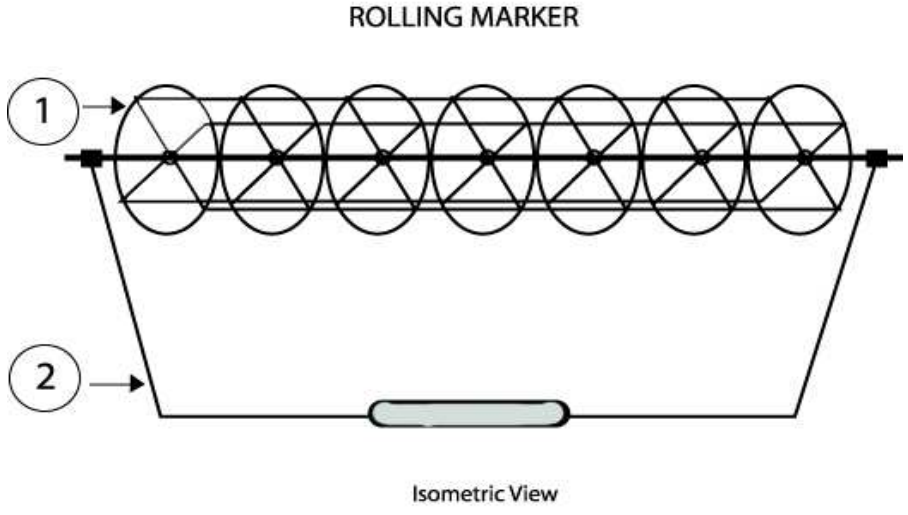

Figure 1: Isometric view of rolling marker
1. Cylindrical marker 2. Handle