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Doubling farmers income through system of rice intensification and comparative analysis of SRI and conventional method of rice cultivation in Theni district of Tamil Nadu

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Abstract

On farm demonstrations on Green manure-System of Rice Intensification (GM-SRI) were carried out in 10 hectares farmer's fields in Jeyamangalam, Silvarpatti and Melavadipatti villages of Varaganadhi sub basin, Periyakulam Block, Theni district of Tamil Nadu during September 2018 – February 2019 under Tamil Nadu Irrigated Agriculture Modernization Project (TN-IAMP). Totally twenty one demonstrations were laid out in the sub basin villages. Green manure – System of Rice Intensification (GM-SRI) and conventional method of rice cultivation were the two rice cultivation methods compared in the farmers field. Results revealed that adoption of Green manure followed by System of Rice Intensification recorded higher yield attributes of rice viz., number of productive tillers m⁻², length of panicle and numbers of grains panicle⁻¹ and there by increased grain yield and straw yield. GM-SRI resulted in 17.0 per cent yield increment than the conventional method of cultivation besides the substantial water saving of 29 per cent and 7.7 kg/ha mm water use efficiency. Higher grain yield coupled with substantial water saving resulted in higher Water Use Efficiency of rice under Green manure - SRI method. Higher gross income, net profit and benefit cost ratio were also associated with Green manure-SRI than conventional method of rice cultivation. The cost of cultivation was comparatively lesser in Greenmanure - SRI which resulted in gaining an additional net profit of Rs. 53643 ha⁻¹ in Greenmanure - SRI as compared to conventional method of rice cultivation.

Keywords: Green manure-SRI, yield attributes, grain yield, water productivity, economics

Introduction

Rice is grown under a wide range of latitudes and altitudes and can become the anchors of food security in a world with the challenges of climatic change. (Swaminathan, 2006) [8]. Rice is the staple food crop of India providing 43 per cent calorie requirement for more than 70 per cent of India's population. Geometric growth of population and arithmetic increase in food grain production leave a vast gap in food supply. This gap is further widened due to urbanization and industrialization of fertile lands. To meet the demands of increasing population and maintain self sufficiency the present level needs to be increased. This increase in production is achieved in the back drop of declining and deteriorating resource base such as land, water and labour and other inputs and without adversely affecting the quality of the environment (Viractamath, 2006). The major constraints in the rice production are lack of integrated management practices involving land, labour, crop, water and inputs such as seeds, fertilizers, optimum plant population. Increasing the rice productivity by the use of appropriate agronomic management practices become an essential component of rice production technology (Sridevi, 2006) [6]. System of Rice Intensification is a new approach, now gaining popularity as it is found to increase the productivity and reduce the cost of cultivation. The concept of SRI includes transplanting young seedlings, singly and widely spaced with soil kept well aerated. Rao *et al.*, (2006) [5] reported that yield attributing character such as tiller number, panicles per m⁻², spikelet number per panicle were superior under SRI cultivation at 25 x 25 cm than under Traditional method of rice cultivation at 20 x 10 cm. Varaganadhi sub basin is one of the sub basins in Tamil Nadu under with the registered ayacut area of 1858.57 ha.

Varaganadhi River originates from Berijam Lake in Kodaikanal of Dindigul district and runs through Periyakulam Taluk of Theni district. The Sothuparai Reservoir was constructed across Varaganadhi in Periyakulam Taluk. The Varaganadhi river after supply of water through anicuts and channels to the ayacut area confluences with Vaigai river near Gullapuram village. The major focus of this basin is to promote water saving technologies, to increase crop and water productivity and to increase the cropped area by diversification. Hence, an attempt was made to study the performance of Green manure - SRI in comparison with the conventional method of rice cultivation in the Varaganadhi sub basin villages.

Materials and Methods

Tamil Nadu Irrigated Agriculture Modernization Project (TN -IAMP) is a World Bank funded project being implemented in Tamil Nadu comprising of eight line Departments including Tamil Nadu Agricultural University, Coimbatore. Varaganadhi is one of the sub basins in Tamil Nadu being in operation at Horticultural College and Research Institute, Periyakulam, Theni District, Tamil Nadu. Twenty one on farm demonstrations on Green manure - System of Rice Intensification (GM-SRI) were carried out in 10 hectares farmer's fields in Jeyamangalam, Silvarpatti, and Melavadipatti villages of Varaganadhi sub basin, Periyakulam Block, Theni District of Tamil Nadu during September 2018 – February 2019. The available soil fertility status of the study area was low in Nitrogen, high in Phosphorus and medium in Potash and sandy clay loam in nature. Two methods of rice cultivation *viz.*, GM-SRI and conventional method were compared by using the variety ADT 45. The green manure Dhaincha was raised @ 50 kg ha⁻¹ and *insitu* incorporated on 45 DAS. In SRI, the concepts *viz.*, lesser seed rate of 7.5 kg ha⁻¹ raised in 100 m² mat nursery, transplanting of 14 days old seedlings at 25 x 25 cm spacing, irrigating 2.5 cm depth of water after hair line crack formation up to panicle initiation and after that one day after disappearance of ponded water and weeding using rotary weeder at 10, 20, 30 and 40 Days After Transplanting (DAT) were followed. In conventional method of rice cultivation, seed rate of 30-60 kg ha⁻¹ in 800 m² nursery area, seedling age 21-30 days with 15 x 10 to 20 x 15 cm, irrigation 5 cm depth one day after disappearance of ponded water and manual weeding twice at 15 and 30 DAT were practiced. The total water use was calculated by adding irrigation water applied and effective rainfall. The observations on yield attributes and grain yield were recorded. Water use and cost economics were also analyzed.

Results and Discussion

Adoption of Green manure – SRI greatly influenced the growth and yield attributes of rice than the conventional method of cultivation.

Yield attributes and Grain yield

The average green biomass yield of Daincha from the twenty one On Farm Demonstrations in the Varaganadhi sub basin was recorded to the tune of 25.2 t ha⁻¹. Green manure application increased the soil fertility by the direct addition of nitrogen and also improves the soil structure, water holding capacity and microbial population of the soil by the addition of humus or organic matter. Rhizobium has ability to fix the nitrogen in association with the leguminous plants which result in meeting the demand of the plant.

Adoption of GM- SRI recorded mean number of productive tillers m² of 456 which was higher than that of conventional

method of rice cultivation which recorded 390 number of productive tillers m². Increased panicle length and numbers of grains panicle⁻¹ were also observed under GM - SRI than conventional method of rice cultivation. GM-SRI registered higher grains panicle⁻¹ and length of panicle of 148 and 22.19 cm respectively. (Table 1). Similar results of higher yield attributes with SRI than conventional method were reported by Kavitha (2008) [2] and Ponni Priya *et al.* (2010) [4].

Grain yield of rice was influenced by the adoption of GM-SRI. Increased mean grain yield of 6450 kg ha⁻¹ was registered by the adoption of GM- SRI which was higher than the conventional method of rice cultivation. Conventional method of rice cultivation was recorded the grain yield of 5510 kg ha⁻¹. (Table 1). The GM- SRI method recorded 17.0 per cent yield increment over conventional method. Among the sub basin villages, the average grain yield of 6500 kg ha⁻¹ was recorded in Jeyamangalam followed by Silvarpatti and Melavadipatti villages. Almost in all the villages per cent grain yield increase in SRI over conventional method was 17.1 per cent. (Table 2). Veeraputhiran *et al.* (2008) [9] also obtained 23.1 per cent yield improvement by SRI than farmers practice in Tamirabarani Command areas of Southern Tamil Nadu. Sunil Kumar and Amrendra Kumar (2018) [7] recorded 46.4 per cent increase in GM –SRI over the conventional method of growing rice. Higher yield attributes like number of productive tillers m², length of panicle and numbers of grains panicle⁻¹ attributed the higher grain yield of GM-SRI.

Water use studies

The water use studies of two methods of rice cultivation clearly indicated that the irrigation requirement was highest under conventional method of transplanting (1185 mm) where as in GM-SRI method the irrigation requirement was 837.6 mm. Water saving in GM-SRI over conventional method was 29.0 per cent. The total water use of rice including effective rainfall was drastically reduced due to intermittent and alternate wetting and drying type of irrigation under SRI which was lesser than that of farmers practice. The increased grain yield coupled with water saving under GM-SRI method resulted in higher WUE of rice in the Varaganadhi sub basin area. The average WUE of GM-SRI in all twenty one demonstrations was 7.70 kg ha mm⁻¹ and it was only 4.64 kg ha mm⁻¹ conventional method of rice cultivation. (Table 1). Similar trend of WUE was also noticed by Vikash kumar (2016) [10].

Economic analysis

Cost economics of both method of rice cultivation revealed that the cost of cultivation was comparatively lesser in GM-SRI than the conventional method of rice cultivation. The mean cost of cultivation of twenty one on farm demonstrations for GM-SRI and conventional methods was Rs.55100 ha⁻¹ and Rs.67500 ha⁻¹ respectively. (Table 1). Adoption of GM-SRI was found to reduce the cost of cultivation by Rs.12400 ha⁻¹. The positive point for the spread of SRI for rice hybrid was that there was a saving of Rs. 1500/ha in the seed cost besides that of water to an extent of 30 to 50 per cent (Viraktamath, 2006) [11]. GM-SRI registered the mean highest net return of Rs.53643 ha⁻¹ and Benefit cost ratio of 1.97 compared to conventional method. Conventional method registered lowest net return of Rs.25348 ha⁻¹ and Benefit cost ratio of 1.38. Similar trend was observed by Chellamuthu and Sridevi (2006) [1] that combination of young seedlings, single seedlings, square planting and conoweeding registered the highest net return (Rs. 12,574/ha) and Benefit

cost ratio (1.87) compared to normal practice. Adoption of GM-SRI registered 52.70 per cent increased net returns than the conventional method. (Table 1). Among the villages, the economic returns viz., Net returns and Benefit cost ratio were

found more with Jeyamangalam village followed by Silvarpatti and Melavadipatti villages of Varaganadhi Sub basin. (Table 3). Increased net returns due to adoption SRI was also reported by Mohanty, *et al.*, (2014) [3].

Table 1: Comparison of Yield attributes, yield, economics and water use between Green manure- SRI and Conventional method of rice cultivation. (Mean values of 21 demonstrations)

S. No.	Particulars	GM-SRI	Conventional method
1	No.of productive tillers m ⁻²	456	390
2	Panicle length (cm)	22.19	21.50
3	No. of grains per panicle	148	112
4	Grain yield (kg/ha)	6450	5510
5	Water consumption (mm)	837.6	1185
6	Water Use Efficiency (kg/ha mm)	7.70	4.64
7	Cost of Cultivation (Rs./ha)	55100	67500
8	Net returns (Rs./ha)	53643	25348
9	Benefit cost ratio	1.97	1.38

Table 2: Village wise yield obtained through Green manure –SRI and conventional method

Name of the Village/Block	Demo yield (kg/ha) (GM-SRI)			Conventional yield (kg/ha)			Yield increase over conventional (%)
	Max	Min	Average	Max	Min	Average	
Jeyamangalam/Periyakulam	6850	6150	6500	5820	5230	5525	17.6
Silvarpatti/Periyakulam	6568	6250	6409	5600	5350	5475	17.1
Melavadipatti/Periyakulam	6300	6300	6300	5350	5350	5350	17.8

Table 3: Village wise economics obtained through Green manure -SRI and conventional method

Name of the Village/Block	Demo yield (kg/ha) (GM-SRI)		Economics					
	GM-SRI	Conventional yield (kg/ha)	GM-SRU			Conventional		
			Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	BC ratio	Cost of cultivation (Rs./ha)	Net returns (Rs./ha)	BC ratio
Jeyamangalam/ Periyakulam Block	6500	5525	55100	54588	1.99	67500	25734	1.38
Silvarpatti/ Periyakulam Block	6409	5475	55100	53052	1.96	67500	24891	1.37
Melavadipatti/ Periyakulam Block	6300	5350	55100	51213	1.93	67500	22781	1.34

Conclusion

From on farm demonstrations on Green manure-SRI conducted at Varaganadhi sub basin villages, it was clearly inferred that GM-SRI was the sustainable climate resilient technology lead to 17.0 per cent higher yield and substantial water saving of 29 per cent besides higher water use efficiency and economic returns. Application of green manure increased soil health by improving soil physical, chemical and biological properties. This technology will improve the standard of living of farmers of Varaganadhi sub basin.

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