Effect of System of Rice Intensification Practices in Increasing the Yield of Traditional Varieties of Rice

ABSTRACT

The experiment to evaluate the "Effect of SRI (System of Rice Intensification) practices in increasing the yield of traditional varieties of rice was carried out in the *samba* season of 2022 at south farm in Karunya Institute of Technology and Sciences, Division of Agronomy, Coimbatore. The soil of the experimental field was clay loam, moderately drained low in available N 212 kg ha^{-1}), high (17.4 kg ha^{-1}) medium K (410 kg ha^{-1}) level of organic carbon (0.73%). The experiment was laid in Randomized Block Design and replicated three times. The treatments consisted of 7 rice varieties namely *Illupaipoo samba* (T_1), *Vaalan samba* (T_2), *Mysore malli* (T_3), *Thanga samba* (T_4), *Thooyamalli* (T_5), *Kitcheli samba* (T_6) and *Bhavani* (T_7). The Data collected includes the yield attributes of different traditional rice varieties and was analyzed using analysis of variance. In the recent past, research on the country's rice crop has mostly been concentrated on increasing output, crop resilience to pests and diseases, and has given little attention to cultivating the traditional rice varieties or management options for better establishment and production. Therefore, it is crucial to conduct SRI technique experiments with a few chosen rice varieties in order to gather data and provide guidance on the best variety to choose for the production of high-quality rice and its commercialization The results showed that the variety *Thanga samba* (T_4) produced significantly higher grain yield of 6564 kg ha^{-1} and registered a yield increase ranging from 12 to 63 per cent over the other varieties under evaluation. The highest net return of 176472 ₹ ha^{-1} with B:C ratio of 2.6 was realised under the variety *Thanga samba* (T_4). In conclusion the variety *Thanga samba* (T_4) performed better under SRI method of cultivation.

Keywords: Kitchili samba; System of Rice Intensification (SRI); Thanga samba; yield attributes.

1. INTRODUCTION

Rice (*Oryza sativa*. L) is an important staple food for more than 60 per cent of the world population and hence called as "Global Grain". Rice is India's prominent crop which contributes to economic growth, with nutritional diversity and aids in reducing poverty. India is the second to China worldwide largest producer of rice totalling 113 million tonnes grown on 44-million-hectare area an average yield of 2.6 t ha^{-1}. Rice is the staple food of the South Indian people especially the people of Tamil Nadu. About 2.2-million-hectare area is under rice cultivation in Tamil Nadu and average productivity is 2.8 t ha^{-1} (Agriculture Department Policy note 2020-2021).

By the year 2050 AD, the world will need approximately 800 million tonnes of rice, representing a 26% increase from current production levels. However, this must be achieved while facing challenges such as diminishing natural resources like land, water, labour, and farm inputs at the same time ensuring environmental sustainability. Therefore, there is a pressing need to embrace innovative techniques that enable profitable rice cultivation while addressing these constraints.

A novel approach to rice cultivation known as the System of Rice Intensification (SRI) has gained traction, primarily championed by innovative farmers. Notably, this approach provides several advantages, including a remarkable water saving potential of up to 50%, a significant increase in yield ranging from 20% to 100%, and a substantial reduction in seed requirements by up to 90% (Kesh *et al.,* 2023). SRI incorporates several principles, such as the transplantation of younger seedlings (less than 15 days old) at wider spacing in a square grid pattern, the use of only one seedling hill^{-1}, water management through alternate wetting and drying, mechanical weeding, and the preference for organic compost fertilizer over chemical fertilizers (Akondo *et al.,* 2020). Dinesh *et al.* (2019) revealed that the yield enhancement in SRI method of cultivation can be attributed to the increased number of lengthy panicles, filled grains and reduced number of unfilled grains panicle^{-1}.

India possesses one of the largest collections of rice germplasm globally, showcasing a remarkable genetic diversity of this crop. However, the introduction of high yielding hybrids and advanced agricultural technologies poses a significant challenge to the preservation of the traditional practice of cultivating indigenous rice varieties and landraces. As a result, there has been a recent shift in consumer preference towards traditional varieties, primarily due to their various health benefits. Moreover, traditional rice varieties are valued for their agronomic characteristics such as therapeutic properties, aromatic qualities, and resilience to environmental stresses. Consequently, incorporating traditional rice varieties into daily diets holds the potential to enhance one's overall health status.

Considering the above facts in mind and recognizing the significance of the System of Rice Intensification (SRI) in this region, a field experiment was conducted to examine the impact of SRI practices on increasing the yield of traditional rice varieties.

2. MATERIALS AND METHODS

Field experiment was carried out during *samba* season of 2021 - 2022 at south farm in Karunya Institute of Technology and Sciences, Division of Agronomy, Coimbatore. The experimental site is geographically located in the western agro-climatic zone of Tamil Nadu at 10^0 56'N latitude and 76^0 44'E longitude at an elevation of 474 m above mean sea level. The soil of the experimental field was clay loam, moderately drained low in available N (212 kg ha^{-1}), high in available P (17.4 kg ha^{-1}) medium K (410 kg ha^{-1}) and organic carbon (0.73%). The experiment was laid out in a randomized block design and the treatments includes six different traditional rice varieties *viz*., *Illupaipoo samba* (T_1), *Vaalan samba* (T_2), *Mysore malli* (T_3), *Thanga samba* (T_4), *Thooyamalli* (T_5), *Kitcheli samba* (T_6) where compared with local variety *Bhavani* (T_7) which was used as control and the yield attributing characters were collected with these varieties.

3. RESULT AND DISCUSSION

3.1 Yield Attributes

3.1.1 Productive tillers hill^{-1}

The number of productive tillers hill^{-1} was significantly influenced by the rice varieties evaluated under SRI as shown in (Table 1) *Thanga samba* (T_4) produced significantly higher number of productive tillers/hill (19.78) and the local variety *Bhavani* (T_7) produced lesser number of productive tillers/hill (13.80) compared with other rice varieties evaluated under SRI.

The variation in the number of productive tillers/hills can be attributed to the genetic composition of the crop variety, which is mainly influenced by hereditary factors and differences in its tillering capacity. Similar outcomes have been reported by (Hasani *et al.*, 2021), Kumari and Shanmugan (2020), Haque and Pervin (2015). These studies align with the findings of Khadka *et al.* (2014) who observed that the System of Rice Intensification (SRI) promotes increased tillering and higher yields compared to conventional methods. This is attributed to the SRI approach facilitating more efficient utilization of resources by reducing competition both between plants and within each hill.

3.1.2 Panicle length

It is clearly evident from the results obtained that the panicle length was profoundly influenced by different rice varieties as mentioned in (Table 1) Among the varieties, higher panicle length of 60.37 cm was recorded in the local variety Bhavani (T_7) and *Mysore malli* (T_3) produced shorter panicles of 38.50 cm. The variation in panicle length may be directly related with the growth parameters of varieties. The observed disparities in panicle length could be attributed to the genetic composition of the varieties, which aligns with the findings of Kumari and Shanmugan (2020), Afa *et al.* (2022) Additionally, the adoption of SRI has an impact on panicle length through early transplanting, which provides a longer duration for the optimal development of plant parts and the allocation of increased photosynthates. This leads to the improved development of yield-related traits. Similar outcomes have been reported by Chaudhary *et al*. (2011). Thus, there was 10% increase in panicle length in SRI plants compared to conventional method. (Thakur *et al.* (2011)

3.1.3 Panicle Weight

Panicle weight was significantly influenced by the different rice varieties evaluated under SRI method (Table 1). *Thanga samba* (T_4) was statistically superior and obtained higher panicle weight of 2.93 g and the lower panicle weight of 1.59 g was observed in *Illupaipoo samba* (T_1). The increased number of filled grains panicle^{-1} in Thanga samba (T_4) can potentially lead to an enhancement in panicle weight. This can be attributed to the higher accumulation of biomass during the vegetative stage and its effective translocation towards the reproductive structures. Similar results were also observed by Prajapati *et al.* (2008)

3.1.4 No. of filled grains/panicle

Among the varieties *Kitchili samba* (T_6) recorded significantly higher number of filled grains panicle^{-1} (111.67) which was superior to other varieties and *Vaalan samba* (T_2) recorded significantly lower number of filled grains panicle^{-1} (71) compared with other varieties as shown in (Table 1) Thakur *et al*. (2010) found that implementing SRI management resulted in enhanced root growth, a greater quantity of productive tillers hill^{-1}, longer panicles and an increased number of filled grains panicle^{-1}. Zhimomi *et al*. (2021) suggested that the higher number of filled grains per panicle observed could be attributed to reduced spikelet sterility and increased fertilized sterility.

3.1.5 Fertility percentage

Among the varieties, *Bhavani* (T_7) obtained higher fertility percentage of 89.19 per cent because of a smaller number of unfilled grains (10.67) and lower fertility percentage of 62.84, 68.70 was recorded in *Mysore malli* (T_3) and *Illupaipoo samba* (T_1) as shown in (Table 1) The research conducted by Kumari and Shanmugan (2020) supports that the percentage of grain filling is influenced by multiple factors, including the grains capacity to utilize carbohydrates, the transportation of assimilates from leaves to grains and the balance between sources and sinks in terms of their activity and size.

3.1.6 Thousand grain weight

Different rice varieties evaluated under SRI method had significant influence on test weight. The variety *Thooyamalli* (T_5) recorded significantly higher 1000 grain weight of 23.67 g and *Illupaipoo samba* (T_1) registered significantly lower 1000 grain weight of 18.36 g compared with other rice varieties evaluated under SRI as shown in (Table 1) The increase in test weight might be due to higher number of filled grains panicle^{-1} coupled with high panicle length Zhimomi *et al.* (2021). The variation in grain weight can be attributed to the diverse genetic composition of cultivars and their distinct reactions to the prevailing environmental conditions during the grain filling stage. (Vasanthakumari, 2014)

3.2 Yield

3.2.1 Grain Yield

Significant variations in grain yield were observed during the evaluation of rice varieties under the SRI method (Table 2). A critical look in the rice grain yield revealed that *Thanga samba* (T_4) recorded significantly higher grain yield of 6564 kg ha^{-1} than all other varieties tested. The traditional variety *Thanga samba* (T_4) registered 61, 63, 49, 12, 4, 55 percent yield increase over *Illupaipoo samba* (T_1), *Vaalan samba* (T_2), *Mysore malli* (T_3), *Thooyamalli* (T_5), *Kitchili samba* (T_6), and *Bhavani* (T_7) respectively. The attractive performance of *Thanga samba* (T_4) is attributed to the high increase in yield components of productive tillers hill^{-1} (19.78), filled grains panicle^{-1} (88.67) and panicle weight (2.93 g). Similar findings were reported by Kesh *et al*. (2017), (Vasanthakumari, 2014). Lowest grain yield was recorded in *Vaalan samba* (T_2). This was quite natural due to low productive tillers and DMP. It is important to note that the genetic characteristics of rice cultivars also play a significant role in determining the resulting grain yield Ramesh *et al.* (2019). The potential cause for the enhanced grain yield observed in SRI could be attributed to improved root development and increased sunlight interception resulting from wider spacing which might have led to more nutrient uptake to the source as reported by Zhimomi *et al*. (2021) and Thakur *et al.* (2010).

3.2.2 Straw Yield

Straw yield was significantly influenced by the different rice genotypes evaluated under SRI. *Thanga samba* (T_4) recorded significantly higher straw yield of 9721 kg ha^{-1}. Significantly lower straw yield was realized in *Mysore malli* (T_3) with 6525 kg ha^{-1}. Vijayakumar *et al*. (2019) reported that the increased straw yield can be attributed to maximum number of tillers, which subsequently led to the accumulation of more dry matter.

3.3 Economics

The cost involved in the SRI method of cultivation ranged from 110411 ₹ ha^{-1} to 110571 ₹ ha^{-1}. The highest net return of 176472 ₹ ha^{-1} was recorded in *Thanga samba* (T_4) and with highest B:C ratio of 2.6 because of higher grain yield. The lowest grain yield was recorded in *Illupaipoo samba* (T_1) but it was economically viable because the cost of produce was higher (65 ₹ kg^{-1}) with B:C ratio of 2.6 (Table 2). The variety *Bhavani* (T_7) registered lower net returns of 54601 ₹ ha^{-1} with B:C ratio of 1.5. The income generated from a crop depends on various factors including the yield level, market price of the produce, and the costs associated with cultivation. In situations where the production costs remain consistent, cultivars that yield higher outputs offer greater returns and benefits per unit of investment. Net income was more in SRI compared to conventional method of rice cultivation and hence benefit cost ratio was also more for SRI method (1:2.2) than the conventional method of rice cultivation (1:1.9) as reported by Kumar *et al.* (2017)

Table 1. Yield attributing characters of different traditional rice varieties under SRI

Treatments	No. of productive tillers/hill	Panicle length (cm)	Panicle weight (g)	No. of filled grains/panicle	Fertility %	1000 grain weight (g)
T_1 – *Illupaipoo samba*	16.80	59.20	1.59	82.67	68.70	18.36
T_2 – *Vaalan samba*	15.03	58.17	1.82	71.00	85.54	23.60
T_3 – *Mysore malli*	16.03	35.50	1.79	76.67	62.84	22.45
T_4 – *Thanga samba*	19.78	48.83	2.93	88.67	85.53	23.39
T_5 - *Thooyamalli*	17.87	50.56	2.20	87.33	84.52	23.67
T_6 – *Kicheli samba*	18.01	56.30	2.28	111.67	85.90	19.60
T_7 – *Bhavani*	13.80	60.37	2.18	88.00	89.19	21.86
Mean	16.76	52.70	2.11	86.57	80.32	21.85
SE(d)	1.37	4.22	0.16	8.01	-	1.45
CD (P = 0.05)	3.01	9.30	0.34	17.65		3.19

Table 2: Grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) and economics of rice varieties under SRI

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Cost of cultivation	Gross returns	B:C ratio
T_1 – *Illupaipoo samba*	4079	6800	110571	282124	2.6
T_2 – *Vaalan samba*	4028	6938	110491	259026	2.3
T_3 – *Mysore malli*	4414	6525	110411	192890	1.7
T_4 – *Thanga samba*	6564	9721	110411	286883	2.6
T_5 - *Thooyamalli*	5910	9472	110411	260066	2.4
T_6 – *Kicheli samba*	6307	9013	110411	274807	2.5
T_7 – *Bhavani*	4247	6572	110491	165092	1.5
Mean	5079	7863	110457	245841	2.2
SE(d)	245	374			
CD (P = 0.05)	526	802			

4. CONCLUSION

It was concluded that SRI method of rice cultivation was more suitable than conventional method in respect of growth and yield of traditional rice varieties. Among the seven varieties, *Thanga samba* (T_4) exhibited the best performance in relation to its yield parameters.

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