Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(3): 3046-3049
Received: 18-03-2018
Accepted: 21-04-2018

N Bommayasamy
Ph.D., Scholar, Department of Agronomy, AC & RI, Madurai, Tamil Nadu, India

Nallaiah Durairaj
Professor (Rtd), Department of Agronomy, AC & RI, Killikulam, Tamil Nadu, India

Correspondence
N Bommayasamy
Ph.D., Scholar, Department of Agronomy, AC & RI, Madurai, Tamil Nadu, India

Influence of non-monetary inputs on growth, yield and economics of rice under System of Rice Intensification (SRI)

N Bommayasamy and Nallaiah Durairaj

Abstract
A field experiment was conducted during late *pishanum* season (2004-05) at Agricultural College and Research Institute, Killikulam, to study the effect of non monetary inputs on growth and yield of rice under SRI method. The experiment was conducted in split and split plot design with type of nursery and age of seedlings in main plot, spacing (20 x 20 cm, 25 x 25 cm and 30 x 30 cm) in sub plot and number of seedlings hill^{-1} (single and double) in sub sub plot. The nursery type and age of seedlings did not show any significant difference in influencing all the growth traits at all the stages. Adoption of higher plant density at 25 hills m^{-2} had pronounced effect in producing higher plant height, leaf area index and crop growth rate at all the stages. The nursery type did not show any significant impact on grain and straw yield. However, it was numerically higher under 14 days old conventional nursery (7788 kg ha^{-1}) compared to other nursery methods. Increase in grain yield with 20 X 20 cm spacing was 5.9 and 11.7 per cent higher over 25 X 25 cm and 30 X 30 cm respectively. Numbers of seedlings failed to influence productive tillers m^{-2}, number of filled grains panicle^{-1} and also failed to influence grain yield, straw yield and harvest index and thereby economics.

Keywords: nursery, age of seedlings, spacing's, number of seedlings, light transmission

Introduction
Rice (*Oryza sativa* L.) is the prime source of food for nearly 50 per cent of the global population. World's 90 per cent of rice are produced and consumed in Asia (Venkataramani, 2002) [17]. System of Rice Intensification is a holistic agro-ecological crop management technique seeking alternatives to the conventional high input oriented agriculture, though effective integration of crop-soil-water-continum (Ditta and Patti, 2002) [6]. In SRI Methodology, it is noticed that the productivity will not only increase but cost of cultivation as well as input use efficiency will also be enhanced (Ghosh *et al.,* 2007) [7]. The water requirement of rice is to meet the demand of nutrient, soil processes and has certain amount of plasticity. Experience with SRI methods suggests that average rice yields can be doubled without requiring a change in cultivars or purchased input (Wang *et al.,* 2002) [18]. In the present investigation, an effort was made for assessing the influence of non monetary inputs such as type and age of seedlings, spacing and number of seedlings on yield and economics of rice.

Materials and Methods
A field experiment was conducted during *late pishanum* season (December to March, 2004-05) at Agricultural College and Research Institute, Killikulam, Tamil Nadu. The soil was sandy clay with medium organic carbon (0.58 per cent), low in available nitrogen (270.6 kg ha^{-1}), medium in available phosphorus (18.7 kg ha^{-1}) and medium in available potassium (224. kg ha^{-1}). Experiment was laid out in Split Split design with three replications. In Main plot, type of nursery with age of seedlings (SRI nursery at 14 days old, conventional nursery at 14 days old and conventional nursery at 21 days old) were assigned while three spacing (20 X 20 cm, 25 X 25 cm & 30 X 30 cm) was assigned to sub plots. In Sub sub plots, number of seedlings hill^{-1} (single and double) was assigned. The recommended dose of fertilizer (120: 38: 38 kg NPK ha^{-1}) was applied through urea, single super phosphate and muriate of potash The plots were irrigated to 2.5 cm depth after the formation of hairline cracks on the soil surface from planting to panicle initiation. After that same water depth of 2.5 cm was allowed one day after the disappearance of previously ponded water until maturity. Need based plant protection measures were given whenever the incidences were more than economic threshold level. Growth and yield parameters were recorded as per standard procedures. Economics was calculated based on the input and output costs.

Results and Discussion

Nursery type and age of seedlings did not influence significantly growth attributes such as plant height at maturity stage, leaf area index, and light transmission ratio and crop growth rate (Table 1). However, raising of seedlings in conventional nursery and transplanting at 14 days registered numerically higher values compared to SRI nursery with 14 days and conventional nursery with 21 days. Growth attributes of paddy is mainly governed by monitory inputs such as fertilizers, weed management etc which could be the reason for less influence of nursery type and age of seedlings on growth attributes. Similar results were earlier reported by Patel, 1999 [10]; Ramamoorthy, 2004 [12]; Among the different spacing, 20 X 20 cm recorded taller plants compared to 25 X 25 and 30 X 30 cm. As a consequence of taller plants, leaf area index at tillering stage (2.73) and flowering (5.74) was also higher. Light transmission at tillering and flowering was significantly influenced by spacing. Wider spacing recorded higher light transmission ratio of 50.46 at tillering and 48.49 at flowering which is significantly different from 25 X 25 cm and 20 X 20 cm. Significantly higher crop growth rate of 213.47 and 189.36 kg ha^{-1} day^{-1} was recorded with 20 X 20 cm spacing which is mainly due to lower transmission ratio. The crop growth rate was lower in 30 X 30 cm spacing. Similar findings reported by Krishna and Biradarpatil, 2009 [9]; Rajput *et al.,* 2017 [11]. Plant height and light transmission ratio was significantly influenced by number of seedlings $hill^{-1}$. Taller plants and higher light transmission ratio was recorded with single seedlings $hill^{-1}$. Number of seedlings $hill^{-1}$ failed to influence the leaf area index and crop growth rate. It corroborates the findings of Devaranavadgi *et al.* (2003) [3]. What was true of growth attributes is true for yield attributes also except percent spikelet sterility (Table 2). Lowest spikelet sterility was observed in conventional nursery with 14 days old seedlings (13.04 per cent) which is on par with 21 days old seedlings under conventional method. Lower spikelet sterility percent in conventional nursery could be due to conditioned seedlings produced in conventional type of nursery. Earlier findings also confirm the results (Senthilkumar, 2002) [14]. Closer spacing led to significantly higher number of productive tillers m^{-2} (493 m^{-2}) followed by 25 X 25 cm and 30 X 30 cm spacing. However, wider spacing of 30 X 30 cm led to significantly higher panicle weight (2.7 g) and number of filled grains panicle (133.68). Higher number of filled grains $panicle^{-1}$ in wider spacing could be attributed to less percentage of spikelet sterility (9.74). Similar findings reported by Durga *et al.,* 2015 [5]. Test weight was not influenced by spacing as it is a genetic character mostly. Higher panicle weight was recorded with single seedling $hill^{-1}$ where as significantly lower spikelet percentage was recorded in two seedlings $hill^{-1}$. Number of seedlings failed to influence productive tillers m^{-2}, number of filled grains $panicle^{-1}$ and test weight which can be attributed to lesser influence of number of seedlings on growth parameters such as leaf area index and crop growth rate. Similar results were earlier reported by Dobermann (2003) [4]. Nursery type and age of seedlings did influence neither grain yield nor straw yield (Table 3). It could be attributed to failure of these factors to influence on growth and yield attributes of rice which in turn make up the yield. These findings are in conformity with findings of Thiyagarajan *et al.,* 2002 [16]; Reuben *et al.,* 2017 [13]. Similar trend was observed for harvest index also. Among the spacing tested, wider spacing led to significantly lower yield of 7313 kg ha^{-1} which could be attributed to significantly lower number of productive tillers (390 m^{-2}). 20 X 20 cm spacing recorded significantly higher grain yield of 8172 kg ha^{-1} which is 11.7 percent higher than 30 X 30 cm spacing due to tremendous improvement in the yield attributes at lesser density and which might be due to better utilization of space and other inputs in which heavy and healthy panicles are produced. Straw yield also recorded similar trend except 25 X 25 cm and 30 X 30 cm spacing which were on par. Harvest index was not influenced by spacing. Similar result was reported earlier by Ajit Kumar *et al.* (2002) [1]. Number of seedlings $hill^{-1}$ also failed to influence grain yield, straw yield and harvest index which could be due to failure of its influence on growth parameters such as leaf area index and crop growth rate and yield parameters such as productive tillers m^{-2} and number of filled grins panicle. Numerically higher grain yield was recorded with two seedlings $hill^{-1}$. These findings are in line with Shrirame *et al.,* 2000 [15]; Bommayasamy *et al.,* 2010 [2].

Higher gross return (Rs. 67422 ha^{-1}) and net return (Rs. 42215 ha^{-1}) with B : C ratio of 2.67 was recorded in conventional nursery with 14 days old seedlings is mainly due to numerically higher grain and straw yield recorded in the same treatment coupled with less difference in cost of cultivation between SRI and conventional nursery. Similarly 20 X 20 cm spacing recorded net return of Rs 42,735 ha^{-1} which is 4.1 and 7.9 percent higher than 25 X 25 cm and 30 X 30 cm spacing respectively. However, the highest benefit cost ratio was recorded with 30 X 30 cm spacing (2.65) which might be due to lower seed rate, less labour required for transplanting and harvesting. Two seedlings $hill^{-1}$ registered higher net return of Rs. 41933 ha^{-1} with B:C ratio of 2.62 which is 4 percent higher. Slightly higher number of productive tillers m^{-2} and number of filled grains $panicle^{-1}$ leading to numerically higher grain and straw yield could be attributed for higher net returns and B: C ratio. Kewat *et al.* (2002) [8] also reported the similar findings.

Table 1: Influence of non monetary inputs on growth attributes on rice

Treatments	Plant height (cm)	Leaf area index		Light transmission ratio		Crop growth rate (kg ha^{-1} d^{-1})	
		Tillering	flowering	Tillering	Flowering	Tillering	Flowering
Types of nursery and age of seedlings							
SRI + 14 d	84.57	2.50	5.30	48.01	45.91	198.86	178.31
Con + 14 d	88.61	2.64	5.56	46.78	44.61	202.10	181.19
Con + 21 d	86.06	2.57	5.44	47.37	45.23	201.20	180.13
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS
Spacings							
20 x 20 cm	95.78	2.73	5.74	44.31	41.99	213.47	189.36
25 x 25 cm	84.84	2.57	5.46	47.40	45.26	195.32	180.34
30 x 30 cm	78.62	2.41	5.11	50.46	48.49	193.38	169.92
CD (P =0.05)	3.03	0.09	0.19	1.51	1.43	6.83	6.07
Number of seedlings $hill^{-1}$							

Single	88.69	2.60	5.48	48.13	46.03	199.78	177.38
Double	84.14	2.53	5.38	46.65	44.46	201.67	182.37
CD (P =0.05)	2.73	NS	NS	1.37	1.30	NS	NS

SRI: SRI Nursery, Con: Conventional nursery

Table 2: Influence of non monetary inputs on yield attributes on rice

Treatments	Productive tillers m^{-2}	Panicle weight (g $panicle^{-1}$)	No of filled grains $panicle^{-1}$	% of Spikelet sterility	Test weight (g)
Types of nursery and age of seedlings					
SRI + 14 d	431	2.53	121.76	15.08	15.52
Con + 14 d	449	2.63	129.09	13.04	15.59
Con + 21 d	436	2.59	127.92	14.13	15.56
CD (P = 0.05)	NS	NS	NS	1.15	NS
Spacing					
20 x 20 cm	493	2.46	118.21	19.10	15.36
25 x 25 cm	433	2.58	126.88	13.41	15.61
30 x 30 cm	390	2.70	133.68	9.74	15.71
CD (P = 0.05)	13	0.09	3.70	0.58	NS
Number of seedling $hill^{-1}$					
Single	436	2.67	125.45	13.07	15.50
Double	441	2.49	127.06	15.10	15.62
CD (P = 0.05)	NS	0.08	NS	0.52	NS

Table 3: Grain, straw yield and economics of rice as influence of non monetary inputs

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest Index	Gross return (Rs ha^{-1})	Net return	B : C ratio
Types of nursery and age of seedlings						
SRI + 14 d	7665	8624	0.382	66306	40943	2.61
Conv + 14 d	7788	8789	0.385	67422	42215	2.67
Conv + 21 d	7747	8736	0.380	67051	40208	2.50
SEd	205	233	0.01	-	-	-
CD (P = 0.05)	NS	NS	NS	-	-	-
Spacing's						
20 x 20 cm	8172	9270	0.380	70843	42735	2.52
25 x 25 cm	7715	8517	0.383	66410	41042	2.62
30 x 30 cm	7313	8362	0.384	63527	39589	2.65
CD (P = 0.05)	265	299	NS	-	-	-
Number of seedling $hill^{-1}$						
Single	7639	8594	0.382	66078	40310	2.56
Double	7828	8839	0.383	67774	41933	2.62
CD (P = 0.05)	NS	NS	NS	-	-	-

Conclusion

14 days old seedlings raised through conventional nursery with 20 X 20 cm spacing and two seedlings $hill^{-1}$ can be recommended for realizing higher grain yield of 8 t ha^{-1} with higher net returns and B:C ratio.

References

1. Ajit Kumar, Mishra BN, Mishra PK. Effect of age of seedlings and plant density on growth and yield of hybrid rice. Ann. Agric. 2002; 23(3):381-386.
2. Bommayasamy N, Ravisankar N, Subramani T. Influence of non-monetary inputs on growth and yield of rice (*Oryza sativa*) under system of rice intensification (SRI). Indian Journal of Agronomy. 2010; 55 (2):95-99.
3. Devaranavadgi SB, Hunashal CS, Patil MB, Venkatesh H, Wali SY. Effect of alley cropping on light transmission ratio, growth and yield of winter sorghum (*Sorghum bicolor*) under semi-arid environment. Indian J Agron. 2003; 48(2):108-110.
4. Dobermann A. A critical assessment of the system of rice intensification (SRI). Agricultural Systems. 2003; 79:261-281.
5. Durga KK, Sambasiva Rao P, Raju K. Effect of seedling age and spacing schedule on the productivity and quality traits of rice under system of rice intensification (SRI). Journal of cereals and oil seeds. 2015; 6(3):15-19.
6. Dutta A, Padi TK. SRI-A Promising Methodology for rice farmers of Orisa. In: National symposium-System of Rice Intensification in India, 1st to 3rd December, TNAU, Coimbatore, Tamil Nadu, India. 2008, 172.
7. Ghouh A, Rao KS, Pandey MP, Poonam A. System of Rice Intensification – A Holistic management Towards Enhancing Rice Production in Future. Towards a learning Alliance – SRI in Orissa, 2007, 35.
8. Kewat ML, Agrawal SB, Agrawal KK, Sharma RS. Effect of divergent plant spacings and age of seedlings on yield and economics of hybrid rice (*Oryza sativa*). Indian J Agron. 2002; 47 (3):367-371.
9. Krishna A, Biradarpatil NK. Influence of age and spacing on seed yield and quality of short duration rice under system of rice intensification cultivation. Karnataka J. Agric. Sci. 2009; 22(1):53-55.
10. Patel JR. Response of rice (*Oryza sativa*) to time of transplanting, spacing and age of seedlings. Indian J. Agron. 1999; 44(2):344-346.
11. Rajput A, Rajput SS, Jha G. Physiological parameters leaf area index, crop growth rate, relative growth rate and net assimilation rate of different varieties of rice grown under different planting geometries and depths in SRI, Int. J. Pure App. Biosci. 2017; 5(1):362-367.
12. Ramamoorthy M. Studies on improved irrigation and weed management practices on growth and yield of

squarely planted rice. M.Sc. (Ag) Thesis, TNAU, Killikulam, Tamil Nadu, India, 2004.
13. Reuben P, Katambara Z, Kahimba FC, Mahoo HF, Mbungu WB, Mhenga F *et al*. Influence of Transplanting Age on Paddy Yield under the System of Rice Intensification. Agricultural Sciences. 2017; 7:154-163.
14. Senthilkumar K. Productivity of hybrid rice as influenced by methods of establishment, management of water, weed and nutrients. M.Sc (Ag.) Thesis, TNAU, Coimbatore, 2002.
15. Shrirame MD, Rajgire HJ, Rajgire AH. Effect of spacing and seedling number per hill on growth attributes and yield of rice hybrids under lowland condition. J Soils and Crops. 2000; 10(1):109-113.
16. Thiyagarajan TM, Velu V, Ramasamy S, Durgadevi D, Govindrajan K, Priyadarshini R *et al*. Effect of SRI practices on hybrid rice performance in Tamil Nadu, India. In: Water wise rice production Edn. By Bouman B A M, Hengsdijk H, Hardy B, Bindraban P S, Towng T P, Zadha J K IRRI Publication, Philippines. 2002, 119-127.
17. Venkataramani G. Policies need to be farmers - friendly. Survey of Indian Agriculture. 2002, 5.
18. Wang S, Cao W, Jiang D, Dai T, Zhu Y. Physiological characteristics and high yield techniques for SRI Rice. In: Assessments of System of Rice Intensification: Proceedings of an International Conference, Sanya, China. 2002; 1-4:116-124.