



Effect of different crop establishment methods and organic nutrient sources on growth and productivity Organic Basmati rice in Jammu region

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Abstract

A field experiment was conducted during the *Kharif* season of the year 2016-17, 2017-18, 2018-19 and 2019-20 at Research farm, Organic Farming Research Centre, Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha to find out most suitable crop establishment methods on growth and productivity Organic Basmati rice in Jammu region. The System of Rice Intensification (SRI) practices have been developed in order to increase the production and quality of rice. Based on SRI practices the rice seedlings are transplanted at the young ages, 10-12 days old with just 2 leaves and carefully planting of just one seedling per hill and space the hills optimally widely in a square pattern of 25×25 cm for better usage of water, sunlight, minerals, space, nutrient, weeding and pest management within shallow depth (1-2 cm) in the moist soil condition. The results revealed that application of Vermicompost 3.0 t ha⁻¹ followed by FYM @ 8 t ha⁻¹ recorded maximum yield (37.77 and 36.94 q ha⁻¹ respectively). It can be attributed due to improved growth parameter like plant height, tillering, root number, number of effective tillers per hill, days to flowering and harvest index of organic basmati rice (Basmati 370), increased panicle production and filled grains panicle⁻¹ in both treatments. In addition, SRI was found effective in minimizing pest and disease incidence, shortening the crop cycle, and improving plant stand. The improved panicle characteristics, lower plant lodging percentage and higher harvest index that ultimately led to comparable grain yields of organic basmati rice. Under organic management with SRI Basmati 370 responded better to nutrient applications with yield superiority of 35%. The maximum additional net return due to SRI technology of Rs 92534 /ha was recorded under Vermicompost 3.0 t ha⁻¹, which was at par of FYM @ 8 t ha⁻¹ Rs 89646/ha.

Keywords: system of rice intensification, conventional, nutrients, organic basmati rice

Introduction

India has the world's largest area devoted to rice cultivation, and it is the second largest producer of rice after China. India provides around 21% of global rice production from its 28% of the world's rice area. Over half of its rice area is irrigated, contributing 75% of the total production. Notably, this area also consumes 50-60% of the nation's finite freshwater resources. Of the country's 1.15 billion inhabitants, 70% rely on rice for at least a third of their energy requirements. India's population is projected to grow to 1.6 billion in 2050, putting tremendous future strain on its land and water resources (Thiyagarajan and Gujja, 2012) [7].

Rice (*Oryza sativa* L.) is the premier food crop of India and therefore, national food security system largely depends on the productivity of rice in different ecosystems. Among the rice growing countries India stands first in area (36.95 m ha) and second in production (120.6 mt) next only to China. However, the average productivity of rice in India is only 3.26 t/ha against the global average of 4.37 tonnes per hectare (FAO STAT, 2018) [2]. In Jammu and Kashmir State the rice crop is cultivated over an area of 274.0 thousand hectares with a production of around 904.4 thousand tonnes and a productivity of 3.24 t/ha. However, in Kashmir valley the area under rice is 158.0 thousand hectares with a production of 576 thousand tonnes and productivity of 3.645 t/ha (Economic Survey, 2013-14).

System of rice intensification, known as SRI method has the potential of increasing the rice yield. The System of Rice Intensification (SRI) begins with a philosophy that rice plants are to be respected and supported as *living creatures* that have great potential. This potential will only be realized if we provide plants with the best conditions for their growth. If we help plants to grow in new and better ways, they will repay our efforts several times over. For rice plants to be more productive, they need to have: More and fertile tillers per plant (panicles) and more grains per fertile tiller. The SRI has sometimes been considered too labor intensive for widespread adoption (Moser and Barrett, 2003) [3], but this appears to be a time dependent assessment. A number of evaluations have shown that SRI can become labor saving once methods and skills have been mastered (Sinha and Talati, 2005) [5]. The as such adoption of SRI is difficult for farmers as age of seedling at the time of transplanting is only 8-12 days and only one seedling is required to transplant per hill. These things are very difficult for farmers to understand and adopt. Looking to this, an attempt has been to make to find out rational way of SRI adoption in rice crop by Satyanarayana *et al.* (2007) [4]. System Rice Intensification (SRI) is an age-old cultural operations of paddy rice cultivation that were collected and analyzed then later on modified by Thurn *et al.* (2006) [8]. He was

able to make the following crop husbandry methodology i.e., use of younger and tender seedlings, avoidance of root damage, wider spacing, creating aerobic soil condition and enhancing organic matter content that leads to the alleviation of the sufferings of million farmers for decades (Uphoff, 2006) [9]. A specialized implement fitted to transplant rice seedling in paddy field have been under development for years by different researchers improving performance, components functions, simplifying the mechanism and handling but until today there is no single machine fully automated for SRI system. A machine transplanting rice requires less time and labor compared to manual, increasing area coverage per person from 700-10,000 m² per day. Rice transplanter was first developed in Japan in 1960's.

Material and Method

An experiment was conducted during the *Kharif* season of the year 2016-17, 2017-18, 2018-19 and 2019-20 at Research farm, Organic Farming Research Centre, Sher-e- Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha. The plot size of an experiment was 5.0 m x 4.0m and variety Basmati 370. The experiment was laid out in Split Plot Design (SPD) two establishment method and five nutrients treatments with three replications. The comprising of two crop establishment methods E₁: System of Rice Intensification (SRI); 10-12 days old with just 2 leaves seedlings and 25x25 cm spacing, E₂: Conventional method; Spacing 20 cm x 15 cm, seedling age 25 -30 days, 5-10 seedlings per hill. Nutrients treatments; T₁ Zero nutrients, T₂ 6t/ha of Farm Yard Manure (FYM), T₃ 8t/ha of Farm Yard Manure, T₄ 2t/ha of Vermicompost (VC) and T₅ 3t/ha of Vermicompost. The other package of practices was adopted to raise the crop as per the recommendations. The observation on growth parameter viz., plant height (cm), no. of tillers/hill, root length (cm), leaf area, Leaf Color Chart (LCC) were recorded. The yield and yield contributing observations were recorded at crop maturity stage.

Result and Discussion

Plant growth and yield attributes

The different levels of treatments measures exhibited significant variation in respect of growth parameters. Vermicompost @ 3 t/ha (Table 1) produced taller plant closely followed by FYM @ 8 t/ha as compared to zero manure treatment. The superiority of Vermicompost @ 3 t/ha and FYM @ 8 t/ha at 60 Days After Transplanting (DAT) stage in term of plant height might have accrued to increase. Similarly maximum number of tillers per plant in Basmati 370 crop was recorded with Vermicompost @ 3 t/ha and FYM @ 8 t/ha at 60 Days After Transplanting (DAT) stage (20.50 and 18.75) under System of Rice Intensification method. Dry matter production is the resultants of growth characters viz. plant height, number of tillers/plant and leaf area index and leaf color chart of organic basmati rice crop with Vermicompost @ 3 t/ha and FYM @ 8 t/ha under System of Rice Intensification method (Table 1).

The results showed that SRI practices showed that application of organic manure improved growth attributes like plant height, tillering, root number, number of effective tillers per hill, days to flowering and harvest index of basmati rice, increased panicle production and filled grains panicle¹, produced high grain yields and fetched the high gross return comparable to those of conventional method. In addition, SRI was found effective in minimizing pest and disease incidence, shortening the crop cycle, and improving plant stand. The improved panicle characteristics, lower plant lodging percentage and higher harvest index that ultimately led to comparable grain yields of Basmati Rice. The results revealed that application of Vermicompost 3.0 t ha⁻¹ followed by FYM @ 8 t ha⁻¹ recorded maximum yield (37.77 and 36.94 q ha⁻¹ respectively) under System of Rice Intensification method.

Table 1: Growth, Yield attributes and Yield observations of Organic Basmati Rice as influenced by crop establishment methods and organic nutrients

Treatments	Dose	Plant height at 60 DAT	No. of Tiller at 60 DAT	leaf area index at 60 DAT	LCC at 60 DAT	Grain yield q/ha
E1F0	Zero	87.85	11.00	38.78	3.00	15.86
E1F1	6tFYM	93.97	16.00	41.59	3.58	33.19
E1F2	8tFYM	104.69	18.75	55.68	4.33	36.94
E1F3	2tVC	98.99	17.00	45.14	3.75	34.71
E1F4	3tVC	113.04	20.50	59.20	4.58	37.77
SE(m)		0.976	0.351	0.469	0.088	0.559
C.D.		3.04	1.094	1.462	0.274	1.741
E2F0	Zero	84.60	5.92	37.31	2.50	13.52
E2F1	6tFYM	97.29	6.58	45.47	3.42	21.09
E2F2	8tFYM	103.92	7.50	50.44	3.50	26.97
E2F3	2tVC	97.53	6.58	46.92	3.17	24.22
E2F4	3tVC	105.45	8.25	55.76	3.67	27.96
SE(m)		0.649	0.207	0.775	0.137	0.804
C.D.		2.022	0.646	2.414	0.426	2.505

Economics

The highest additional net returns were obtained due to higher sale price and higher grain yield respectively. The maximum additional net return due to SRI technology of Rs 92534 /ha was recorded under Vermicompost 3.0 t ha⁻¹, which was at par of

FYM @ 8 t ha⁻¹ Rs 89646/ha (Table 2). Thus, the result of three years study clearly indicated that Organic Basmati Rice under System of Rice Intensification by Vermicompost 3.0 t ha⁻¹ and FYM @ 8 t ha⁻¹ was recorded higher productivity and profitability of crop.

Table 2: Relative economics of Organic Basmati Rice as influenced by crop establishment methods and organic nutrients

Treatment	Dose	Gross Return	Cost of Production	Net Return	B. C Ratio
E1F0	Zero	55493	39644	15849	1.40
E1F1	6tFYM	116174	39644	76530	2.93
E1F2	8tFYM	129290	39644	89646	3.26
E1F3	2tVC	121494	39644	81850	3.06
E1F4	3tVC	132178	39644	92534	3.33
E2F0	Zero	47320	39644	7676	1.19
E2F1	6tFYM	73815	39644	34171	1.86
E2F2	8tFYM	94404	39644	54760	2.38
E2F3	2tVC	84779	39644	45135	2.14
E2F4	3tVC	97843	39644	58199	2.47

Conclusion

Application of Vermicompost 3.0 t ha⁻¹ followed by FYM @ 8 t ha⁻¹ recorded maximum yield (37.77 and 36.94 q ha⁻¹ respectively) and thus, may be recommended in Organic Basmati Rice under System of Rice Intensification method. Farmers using traditional approaches in Basmati 370 cultivation can double the income by adopting SRI technology with organic management.

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