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EFFECT OF DIFFERENT CROP ESTABLISHMENT TECHNIQUES AND VARIETIES ON GROWTH PARAMETERS AND YIELD OF HYBRID RICE

Sekhar Sing Mura[1], Mahua Banerjee[2] and G.C. Malik, Souvik De[3]
[1,2,3]*Department of Agronomy, Palli Siksha Bhavana (Institute of Agriculture), Visva Bharati, Sriniketan, Pin-731236, West Bengal, India*

Abstract

Rice is the most important staple food crop in the world and a major food grain for more than a third of world's population (Prasertsak and Fukai, 1997). About 40% of world population uses rice as a major source of calories. The use of hybrid rice is a new development in India. Hybrid rice is the commercial rice crop from F1 seeds of cross between two genetically dissimilar parents. A field experiment was conducted during boro season of 2013-14 and 2014-15 in Agricultural Farm, Palli Siksha Bhavana (Institute of Agriculture) at Visva-Bharati, Sriniketan, India which lies in the sub-humid sub-tropical lateritic belt of West Bengal to study the effect of different crop establishment techniques and varieties on growth parameters and yield of hybrid rice. The results showed that between the crop establishment techniques, SRI method showed best results in growth parameters like CGR, LAI and dry matter accumulation and also the grain and straw yield of hybrid rice was superior in SRI technique than that of conventional method of rice cultivation in both the years. Among the varieties, Tej variety showed good results in almost all the parameters than that of other varieties.

Keywords: Hybrid rice, SRI, Crop establishment techniques

I. INTRODUCTION

Rice is the most important staple food crop in the world and a major food grain for more than a third of world's population (Prasertsak and Fukai, 1997). The crop occupies one third of world's total area planted to cereals and provides 35-60% of the calories intake more than two billion people every day (Guerra *et al*., 1998).

Hybrid rice cultivation is a technology which was fully utilized in countries like China where its exploitation has paid rich dividend to alleviate hunger and poverty (Peng *et al.,* 1994). The use of hybrid rice is a new development in India.

Hybrid rice is the commercial rice crop from F1 seeds of cross between two genetically dissimilar parents. Good rice hybrids may yield up to 15-20% more than the best inbred high yielding variety grown under similar conditions. System of rice intensification (SRI) is the method, developed in Madagascar in the early 1980's , where, it has been shown that yields can be enhanced by suitably modifying certain management practices such as controlled supply of water, planting of younger seedling and providing wider spacing (Laulanie,1993).

The main of objective of SRI is to enhance the productivity by better utilization of resources viz. land, labour, capital and water.

By adopting this system of cultivation we could save water, protect soil productivity, save environment by checking methane gas from water submerged water paddy cultivation practices, and bring down the input cost, besides increasing the production. Early transplanting of rice seedlings assume special significance and principle means in obtaining higher yields in SRI cultivation.

II. MATERIALS AND METHODS

A field experiment was conducted during the *boro* season of 2013-14 and 2014-15. The experimental site was situated in the Agricultural Farm of Palli Siksha Bhavana (Institute of Agriculture) at Visva-Bharati, Sriniketan, India which lies in the sub-humid sub-tropical lateritic belt of West Bengal. The experiment was laid out in factorial randomized block design with three replications. Total number of plots was 24 each with gross size of 5m×4 m. Recommended dose of fertilizers were applied through urea, single super phosphate and muriate of potash @ 150 kg N ha^{-1}, 75 kg P_2O_5 ha^{-1} and 75 kg K_2O ha^{-1}. The nursery field and main field of SRI and Conventional method were prepared by following the recommended package and practices.

The observations were recorded on crop growth rate, relative growth rate, net assimilation ratio, grain yield, straw yield and harvest index of rice and were analyzed statistically.

III. RESULTS AND DISCUSSIONS

Crop Growth Rate (CGR)

The crop growth rate was found significantly higher in case of SRI method of crop establishment than that of conventional method of crop establishment in both the years at 30- 45 DAT and at 60-75 DAT. The pooled mean value was also found significantly higher in case of SRI method of crop establishment. Singh *et al*. (2008) reported on similar lines stating that tillers m^{-2}, LAI, dry matter production and CGR are all inter-dependent factors. Among the varieties, crop growth rate of Tej variety was found significantly higher at 30-45 DAT during the year 2015 than that of other varieties. But at 60-75 DAT, though the value of CGR was higher in case of Tej variety in both the years, yet there was no significant difference among the varieties. The value of pooled mean was found higher in case of Tej variety among all the varieties. Siddiq *et al.,* 1996 and Wang *et al.*, 2002 reported high crop growth rate during vegetative periods encouraged tillering, and LAI development that helped in maintaining higher crop growth rate during reproductive period leading to greater spikelet formation grain development and high crop productivity.

Leaf Area Index (LAI)

In between the crop establishment techniques, the LAI value was found significantly higher in case of SRI grown rice seedlings than that of conventional methods in both the years at 45 DAT and at 60 DAT. The pooled mean value was also found higher in case of SRI method of crop establishment technique than that of conventional method. Among the varieties, no such significant difference was observed in both the years at 45 and 60 DAT. The value of LAI was found higher in case of Tej variety of hybrid rice. There was no interaction effect in between crop establishment techniques and variety. Longxing *et al*. (2002), Subbulakshmi *et al*. (2008), Shahane *et al*. (2012) and Singh *et al*. (2008) reported that SRI method recorded significantly higher LAI than conventional transplanting.

Dry Matter Accumulation

The dry matter accumulation was found significantly higher in case of SRI method of crop establishment technique than that of conventional method in both the years at 75 DAT and at harvest. The pooled mean value of dry matter accumulation was also found significantly higher in case of SRI method. There was no significant difference among the varieties in case of dry matter accumulation during 2014 at 75 DAT and at harvest. But in 2015, the value of dry matter accumulation was found significantly higher in case of Tej variety of hybrid rice than that of other varieties.

The pooled mean value was also found higher in case of Tej variety which was significantly different than that of other varieties. No interaction effect was found in between crop establishment techniques and variety. Borkar *et al*. (2008) stated that under SRI method, increased dry matter accumulation was due to adequate availability of nutrients through wider spacing. Kewat *et al*. (2002) and Xiuming *et al*. (2004) also confirmed that dry matter accumulation increased by planting rice following SRI concept as compared to standard transplanting method.

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Table 1: Effect of crop establishment methods and hybrid varieties on CGR, LAI and Dry Matter Accumulation at different growth stages of rice plant

Treatments	CGR						LAI						Dry Matter Accumulation					
	30-45 DAT			60-75 DAT			45 DAT			60 DAT			75 DAT			At harvest		
	2014	2015	P. M.	2014	2015	P. M.	2014	2015	P. M.	2014	2015	P. M.	2014	2015	P. M.	2014	2015	P. M.
Crop Establishment Methods																		
SRI	12.85	16.41	14.13	13.63	12.77	13.20	5.39	6.23	5.81	6.94	7.16	7.05	851.46	868.10	860.78	955.84	975.01	965.43
Conventional	10.27	12.24	11.26	9.60	10.29	9.94	4.43	4.91	4.67	6.21	6.45	6.33	690.38	720.55	704.97	767.78	794.44	781.11
S. Em (±)	**0.40**	**0.28**	**0.29**	**0.83**	**0.72**	**0.66**	**0.15**	**0.22**	**0.11**	**0.17**	**0.20**	**0.15**	**16.68**	**7.66**	**10.17**	**21.96**	**10.62**	**12.25**
C.D. at 5%	**1.21**	**0.44**	**0.90**	**2.53**	**2.21**	**2.00**	**0.46**	**0.68**	**0.34**	**0.53**	**0.60**	**0.45**	**50.60**	**23.23**	**30.85**	**66.62**	**32.21**	**37.15**
Variety																		
Tej	12.15	15.41	14.14	12.31	12.05	12.18	5.38	5.82	5.60	6.80	7.00	6.90	**802.73**	**840.38**	821.05	**902.82**	**936.16**	**919.50**
NK6302	11.78	12.68	12.23	11.51	11.84	11.68	4.78	5.22	5.00	6.25	6.71	6.48	774.11	778.42	776.26	860.16	865.83	862.50
RAJALAXMI	11.40	13.25	12.32	12.04	11.62	11.83	4.84	5.64	5.24	6.71	6.83	6.78	770.24	797.82	783.53	860.28	890.28	875.28
AJAY	10.93	13.20	12.06	10.58	10.60	10.60	4.66	5.61	5.13	6.53	6.68	6.61	735.61	761.66	748.63	824.98	846.64	835.81
S. Em (±)	**0.56**	**0.62**	**0.42**	**1.17**	**1.03**	**0.93**	**0.21**	**0.31**	**0.16**	**0.25**	**0.28**	**0.21**	**23.60**	**10.83**	**14.38**	**31.06**	**15.01**	**17.32**
C.D. at 5%	**NS**	**1.34**	**1.28**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**32.86**	**43.63**	**NS**	**45.55**	**52.54**
A X B interaction																		
S. Em (±)	**0.80**	**0.88**	**0.59**	**1.66**	**1.45**	**1.32**	**0.30**	**0.45**	**0.22**	**0.35**	**0.40**	**0.30**	**33.36**	**15.32**	**20.34**	**43.93**	**21.24**	**24.52**
C.D. at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV %	**12.00**	**11.10**	**8.15**	**24.88**	**21.92**	**19.83**	**10.83**	**13.95**	**7.54**	**9.30**	**10.14**	**7.78**	**7.50**	**3.34**	**4.50**	**8.82**	**4.16**	**4.83**

Grain yield (kg/ha)

Grain yield was found significantly higher in case of SRI method of crop establishment technique than that of conventional technique in both the years. The pooled mean value was also found to be higher in case of SRI technique than that of conventional method. Budhar *et al*. (2006), Narendra Pandey and Om Prakash (2007) also suggested improved soil quality, stronger root and canopy growth with increased grain yield 7) . Among the varieties, Tej variety gave highest grain yield than that of other varieties but there was no significant difference among them. The pooled mean value of grain yield was also higher in case of Tej variety. Nissanka and Bandara (2004) reported that grain yield was in the SRI technique greater than the traditional transplanting.

Straw yield (kg/ha)

Straw yield also followed the same trend as that of grain yield. SRI method recorded higher straw yield than that of conventional technique of crop establishment and there was significant difference between the crop establishment techniques. The pooled mean value of straw yield was also higher in SRI method of crop establishment technique than that of conventional method. Husain *et al*. (2003) found higher straw yield in SRI technique compared to traditional technique. Among

the varieties, Tej variety gave highest straw yield than that of other varieties but there was no significant difference among them. The pooled mean value of straw yield was also higher in case of Tej variety.

Harvest Index (%)

The harvest index of rice plants grown under SRI method of crop establishment technique was significantly higher than that of conventional method in both the years. The pooled mean value of harvest index also followed the same trend. Yoshida, (1981), reported that Efficient assimilate supply to the grain from the source and the capacity of the sink to receive it determines the higher yield and these processes depend highly upon varietal feature, environmental conditions and management factors. Tej variety has the highest harvest index value in 2014 among the varieties but in 2015 Rajalaxmi variety showed the higher value in harvest index. Also the pooled mean value of harvest index was found higher in case of Rajalaxmi variety. Uphoff., (2004) reported that rice hybrids produced around 15 t ha^{-1} while HYV's had a yield potential of 6.2 t ha^{-1} of grain when grown under SRI in Madagascar.

Table 2: Effect of crop establishment methods and hybrid varieties on grain yield, straw yield and harvest index of rice

Treatments	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest index %		
	2014	2015	P.M.	2014	2015	P.M.	2014	2015	P.M.
Crop Establishment methods									
SRI	6361.80	6560.20	6461.00	7175.42	7490.814	7333.18	46.95	46.67	46.81
Conventional	5330.03	5351.52	5340.77	6284.06	6397.61	6340.84	45.96	45.56	45.76
S.Em(±)	**126.34**	**118.20**	**99.47**	**154.98**	**118.91**	**108.15**	**0.90**	**0.70**	**0.68**
CD at 5%	**383.19**	**358.51**	**301.70**	**470.08**	**360.68**	**328.05**	**2.75**	**2.09**	**2.07**
Varieties									
TEJ	6034.66	6109.23	6071.94	6813.63	7156.093	**6984.86**	46.86	46.00	46.43
NK 6302	5816.54	5894.77	5855.66	6781.62	7017.69	6899.68	46.15	45.56	45.85
RAJALAXMI	5858.17	5976.37	5917.27	6685.68	6805.57	6745.63	46.74	46.64	46.70
AJAY	5674.29	5843.08	5758.68	6637.98	6797.50	6717.76	46.07	46.24	46.17
S.Em(±)	**178.67**	**167.16**	**140.67**	**219.18**	**168.17**	**152.95**	**1.28**	**1.00**	**0.96**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
A X B interaction									
S.Em(±)	**252.68**	**236.40**	**198.94**	**310.00**	**237.83**	**216.31**	**1.81**	**1.38**	**1.37**
CD at 5%	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
CV%	**7.48**	**6.87**	**5.83**	**7.98**	**5.93**	**5.48**	**6.76**	**5.18**	**5.12**

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