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Studies on Growth Analysis and Grain Yield in Rice under SRI Cultivation

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ABSTRACT

Two field experiments were conducted during *kharif* seasons of 2007 and 2008 at wetland farm of S.V.Agricultural College Tirupathi to analyze the growth and grain yield in rice under SRI cultivation. The results revealed that significant differences were observed among the varieties and age of seedlings with regard to growth parameters and grain yield at all stages of plant growth. Maximum CGR, RGR, NAR, LAD, SLW and grain yield was produced by SRI -8 days followed by SRI-12 days and least in conventional method -21 days. Among the varieties tested, BPT5204 recorded higher CGR, RGR, NAR, LAD, SLW and grain yield followed by DRRH-2, NLR-145 and BPT3291 .The interaction between varieties and age of seedling was significant.

Key words : Crop growth rate, Grain yield, Growth analysis, Net assimilation rate, System of rice intensification

Rice is one of the most important stable food crops of the world catering to the needs of nearly 60 percent of the population .Increasing production of rice is an important requirement to meet the needs of ever increasing population in India. The system of rice intensification methodology (SRI) was first synthesized in early 1980 by Lavlane Henri De in Madagascar .It is a methodology for increasing the productivity of irrigated rice by changing the management of plants ,soil ,water and nutrients .The positive results from SRI methods have been reported from Madagascar , China ,Philippines , and Srilanka and yield increase of 50-100 percent are common with some times even a tripling of yield under SRI (Zbu Defeng *et al* 2002, Tao Long Xing *et al* 2002 and Thayagarajan ,2002). .Southern zone of Andhra Pradesh was shown to be highly suitable for this technology .Much of the research work has done outside the India but a systematic basic physiological research in this native environment was not been taken up.Net assimilation rate is an index of photosynthetic efficiency which shows strong positive association with photosynthetic rate and grain yield . A significant positive correlation was obtained between LAD during post flowering and yield which was earlier reported by Nijhwan and Chandra (1980). Hence, a detailed study was taken up to know the growth analysis and grain yield of rice under SRI cultivation compared to conventional method.

MATERIALS AND METHODS

Two field experiments were conducted at wetland farm, S.V. Agriculture College Tirupati during *kharif* 2007 and 2008 in factorial randomized block design with 12 treatments and three replications. The treatments composed of 4 varieties (BPT 5204, BPT 3291, NLR 145, and DRRH-2) and 3 types of age of seedlings (SRI-8 days, SRI-12 days, conventional method -21 days). The spacing adopted in SRI cultivation was 25 X 25 cm and conventional method was 20x10 cm. The plots size taken was 5 x 4 mts .The seedlings were raised separately on raised seed beds.

Under SRI method, 8 and 12 days old rice seedlings with two leaves were transplanted, one seedling per hill. From transplanting to 7 days after transplanting, a water layer of 1 to 3 cm depth was maintained on paddy field. From 7 DAT to maturity there was no water layer on the field and soil water was maintained in moist condition by quick irrigation as desired. Under conventional method, 21 days old rice seedling with five leaves was transplanted with two to 3 seedlings per hill. A water layer of 1-5 cm deep was maintained on the rice field during the entire growth period in conventional method. Normal fertilizer dose was applied in both the methods .Cono- weeder was done once in 10 days up to panicle initiation stage in both sides in SRI method. Sampling was done 30 days time interval. The leaf area was measured by LICOR 3000 leaf area meter

Table: 1 Crop growth rate, Relative growth rate, Net assimilation rate and Leaf area duration of rice varieties under SRI cultivation and conventional method (At 90-120 DAT)

Varieties	Crop growth rate(g m-2 day-1)				Relative growth rate (gg-1 day-1)				Net assimilation rate (gm-2 day-1)				Leaf area duration (cm2day-1)			
	SRI		Conv.	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean
Age of seedlings	8	12	21		8	12	21		8	12	21		8	12	21	
BPT 5204	47.00	42.5	23.80	37.77	0.0173	0.0165	0.0125	0.0154	0.24	0.18	0.17	0.19	5.28	4.73	4.09	4.70
BPT 3291	38.56	31.6	19.50	29.88	0.0161	0.0155	0.0115	0.0143	0.18	0.16	0.10	0.14	4.46	4.13	3.29	3.96
NLR 145	41.92	38.5	20.41	33.61	0.0164	0.0158	0.0116	0.0146	0.20	0.18	0.12	0.16	4.90	4.28	3.51	4.23
DRRH 2	45.51	41.3	21.56	36.12	0.0168	0.0161	0.0121	0.0150	0.22	0.20	0.14	0.18	5.11	4.54	3.76	4.47
Mean	43.24	38.4	21.32	-	0.0166	0.0159	0.0119	-	0.21	0.18	0.13	-	4.93	4.42	3.66	-
CD at 0.05																
V				1.50				0.005				0.04				0.20
A				3.77				0.0035				0.05				0.40
V x A				1.53				0.0008				0.03				0.30

V: Varieties A: Age of seedlings Conven: Conventional method

and LAI was computed on the basis of leaf area per unit ground area. Destructive analysis of plant samples was done at 30, 60, 90,120 and at maturity and dried in oven at 80^{oc} for 48 hours .The other growth parameters were computed from leaf area and dry matter .The data on grain yield and yield components were recorded at the time of harvesting. The statistical analysis was done following Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

The data on crop growth rate (CGR) for rice varieties are presented in Table 1. Significant differences were observed among the varieties and different age of seedlings in CGR at 90-120 DAT. Maximum CGR was recorded by SRI -8 days (43.14 g m^{-2} day^{-1}) followed by SRI-12 days (38.47 g m^{-2} day^{-1}) and least in conventional method-21 days (21.32 g m^{-2} day^{-1}). The higher CGR in SRI-8days might be due to more tiller production and total dry matter production .Similar results were reported by Tao long Xing *et al* (2002) in rice. Among the varieties tested, BPT5204 recorded higher values of CGR (37.77 g m^{-2} day^{-1}) ,followed by DRRH-2 (36.12 g m^{-2} day^{-1}) ,NLR145 (33.61 g m^{-2} day^{-1}) and BPT3291(29.88 g m^{-2} day^{-1}) .The interaction between varieties and age of seedlings was significant .

The data on relative growth rate (RGR) and Net assimilation rate (NAR) were presented in table 1. Significant differences were observed among the varieties and different age of seedling with regard to RGR and NAR at 90-120 DAT. SRI -8 days recorded maximum RGR and NAR values followed by SRI-12 days and least in conventional method -21 days. The higher RGR and NAR in SRI-8 days might be due to more total dry matter production, leaf area and SCMR values. Among the varieties tested, BPT5204 recorded higher values of RGR and NAR followed by DRRH-2 , NLR145 and BPT3291.The interaction between varieties and age of seedlings was significant.

The data on leaf area duration (LAD) for rice varieties are presented in Table 1. Significant differences were observed among the varieties and different age of seedlings in LAD at 90-120 DAT. Maximum LAD was

Table 2. Leaf area index, Leaf area ratio and Specific leaf weight of rice varieties under SRI Cultivation and conventional method (At 90 DAT)

Varieties	Leaf area index				Leaf area ratio ($cm^2 g^{-1}$)				Specific leaf weight ($g cm^{-2}$)			
	SRI		Conv	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean
Age of seedling	8	12	21		8	12	21		8	12	21	
BPT 5204	4.53	4.15	3.64	4.11	43.47	44.62	78.36	55.48	3.60	3.39	2.01	3.00
BPT 3291	4.10	3.75	3.05	3.63	54.51	55.65	92.52	67.56	2.70	2.59	1.41	2.23
NLR 145	4.15	3.84	3.19	3.73	49.29	52.00	87.41	62.90	3.01	2.83	1.59	2.47
DRRH- 2	4.31	3.95	3.41	3.89	46.27	47.00	81.33	58.20	3.36	3.24	1.82	2.81
Mean	4.27	3.92	3.32	-	48.38	49.81	84.91	-	3.17	3.01	1.71	-
CD at 0.05												
V				0.15				4.82				0.15
A				0.20				25.4				0.10
V x A				0.05				11.3				0.08

V: Varieties A: Age of seedlings Conven: Conventional method

recorded by SRI -8 days (4.93cm^2 day^{-1}) followed by SRI-12 days (4.42 cm^2 day^{-1}) and least in conventional method-21 days (3.66cm^2 day^{-1}). The higher LAD values in SRI-8 days might be due to more SCMR values. Among the varieties tested, BPT 5204 recorded higher values of LAD followed by DRRH-2, NLR145 and BPT3291. Higher LAD during grain filling stage may be the reason for higher photosynthetic activity in BPT 5204 which helped to accumulate and transport more assimilates into grain and resulted in higher grain yield. A significant positive correlation was obtained between LAD during post flowering and yield which was earlier reported by Nijhwan and Chandra (1980). The interaction between varieties and age of seedlings was significant.

The data on leaf area index (LAI) and specific leaf weight (SLW) of rice varieties are presented in Table 2.. Significant differences were observed among the varieties and different age of seedlings in LAI and SLW at 90 DAT. Maximum LAI and SLW was recorded by SRI -8 days (4.27 and 3.17 g cm^{-2}) followed by SRI-12 days (3.92 and 3.01 g cm^{-2}) and least in conventional method-21 days (3.32 and 1.71 g cm^{-2}). The higher LAI and SLW in SRI-8 days might be due to more tiller production and leaf area and root volume .Similar results were reported by Wang Sbae –bua et *al* (2002) in rice. Among the varieties tested, BPT5204 recorded higher values of LAI and SLW followed by DRRH-2, NLR145 and BPT3291.The interaction between varieties and age of seedlings was significant.

The data on leaf area ratio (LAR) for rice varieties are presented in Table 2. Significant differences were observed among the varieties and different age of seedlings in LAR at 90 DAT. Maximum LAR was recorded by conventional method-21 days (84 cm^2 g^{-1}) followed by SRI-12 days (49.81 cm^2 g^{-1}) and least in SRI-8 days (48.38 cm^2 g^{-1}). Among the varieties tested, BPT3291 recorded higher values of LAR followed by NLR145, DRRH-2 and BPT5204 .The interaction between varieties and age of seedlings was significant.

The data on yield and yield components of rice varieties are given in table 3. The maximum yield was obtained with SRI-8 days (8.2 t ha^{-1}) followed by SRI-12 days (7.65 t ha^{-1}) and conventional method-21 days (5.67 t/ha). Among the varieties, BPT 5204 recorded maximum yield (7.75 t ha^{-1}) followed by DRRH-2 (7.3 t ha^{-1}), NLR -145 (6.93 t ha^{-1}) and BPT-3291 (6.72 t ha^{-1}). The higher yield in SRI-8 days might be due to higher tiller production, no of grains per panicle, test weight, CGR and SCMR. Similar results were reported by Wang Sbao – bua *et al* (2002) in rice.

SRI-8 days recorded higher number of tillers, filled grains per panicle, 1000 grain weight and harvest index followed by SRI-12 days and least in conventional method-21 days. Among the varieties, BPT 5204 recorded maximum tillers per plant, filled grains per spikelets, harvest index followed by DRRH-2 and NLR 145 and BPT 3291. The interaction between varieties and age of seedlings was significant. From the above results it can be

Table 3. Yield and yield components of rice cultivars under SRI and conventional method

Cultivars	Grain yield (t ha^{-1})				No.of panicles plant^{-1}				No.of grains Panicle^{-1}				1000 grain wt (g)				Harvest index			
	SRI		Conv.	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean	SRI		Conv.	Mean
	8	12	21		8	12	21		8	12	21		8	12	21		8	12	21	
BPT 5204	8.80	7.97	6.50	7.75	58.0	47.0	25.3	43.43	195	184	180	186.3	14.85	14.40	14.10	14.45	0.51	0.48	0.47	0.47
BPT 3291	7.71	7.45	5.00	6.72	45.0	38.0	16.5	33.16	173	168	160	167.0	19.40	19.10	18.90	19.13	0.46	0.45	0.39	0.43
NLR 145	7.80	7.50	5.50	6.93	47.0	41.4	18.3	35.56	181	173	165	173.0	20.81	20.68	20.16	20.55	0.48	0.46	0.40	0.44
DRRH 2	8.50	7.70	5.70	7.30	50.0	44.3	21.4	31.43	183	176	170	176.0	20.62	20.26	20.11	20.33	0.50	0.47	0.41	0.46
Mean	8.20	7.65	5.67	—	50.0	42.6	20.3	—	183	175	168	-	18.92	18.61	18.31	—	0.49	0.47	0.41	—
CD at 5%																				
V				0.35				7.43				10.50				0.75				0.02
A				0.47				6.50				7.30				0.50				0.03
V x A				0.26				4.32				4.50				0.25				0.01

V: Varieties A: Age of seedlings Conven: Conventional method

concluded that SRI-8 days produced higher CGR,RGR,NAR,LAD,LAI,SLW ,grain yield and yield components followed by SRI-12 days and least in conventional method -21 days in rice .

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