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Response to Methods of Cultivation and Fertility Levels on Growth and Yield of Hybrid Rice

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A field experiment was conducted during *kharif* and summer seasons of 2010-2011 at ZARS, V.C. Farm, Mandya to study the influence of methods of cultivation and fertility levels on growth and yield of rice hybrids. The experiment consists of 18 treatment combinations involving methods of cultivation (SRI and conventional method of planting), rice hybrids (KRH-2, KRH-4 and Arize (6444) and fertility levels (100 % RDF, 125 % RDF and 150 % RDF) were laid out in double split- plot design with three replications. Higher plant height, more number of leaves plant^{-1}, more number of tillers plant^{-1}, higher leaf area and higher dry matter production plant^{-1}, more number of panicles m^{-2}, higher panicle weight g m^{-2} were recorded in SRI method of rice cultivation with rice hybrid Arize (6444) at 150 % RDF compared to conventional method of planting. SRI method of planting recorded significantly higher grain yield (7717 kg ha^{-1}) and straw yield (8554 kg ha^{-1}) with rice hybrid arize (7808 kg ha^{-1}) compared to KRH-2 (7260 kg ha^{-1}) and KRH-4 (7504 kg ha^{-1}) at 150 % RDF (7821 kg ha^{-1}) than other treatments in the trial.

Key words: Methods of cultivation, Rice hybrids, Fertility levels, System of Rice Intensification, RDF

Rice (*Oryza sativa* L.) is a major staple food for more than half of the world's population. Among rice growing countries, India has the largest area (44 million hectares) and it is the second largest rice producer (131 million tonnes) next to china (197 million tonnes). To meet the food requirement of the growing population, the rice production has to be enhanced with good management practices at the present rate of shrinking of land and water resources. Good crop establishment is one of the vital components for efficient use of resources and input and also for achieving desired level of productivity. System of Rice Intensification is a revived method of transplanted rice cultivation provides favorable growing environment to increase the productivity and economic returns. Besides, it enhances soil health with reduction in input use such as seed, water, labour etc. (Gujja and Thiyagarajan, 2009). The higher yield of rice hybrids can be realized with balanced fertilizer management practices. The role of nitrogen, phosphorus and potassium is vital in this context. Nitrogen and potassium are fundamental to achieve high marketable yield, while phosphorus is essential for early growth and root development. Maintaining optimum soil moisture by practicing good cultivation practice and nutrient status throughout the plant growth is crucial for getting maximum rice yield and until these parameters are not optimized for different location, full potential of rice hybrids could not be realized. Keeping these points in view the present study was undertaken to know the effect of methods of cultivation, fertility levels and rice hybrids on growth and yield of rice hybrids in command area.

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Materials and Methods

A field experiment was conducted during *Kharif* and summer seasons of 2010-2011 at ZARS, V.C. Farm, Mandya, Karnataka to study the response of methods of cultivation and fertility levels on growth and yield of rice hybrids. The soil of the experiment site was red sandy loam, slightly acidic in nature (pH 6.05), low in organic carbon content (0.42 %), medium in available soil nitrogen (274.60 kg/ha), phosphorus (27.2 kg/ha) and potassium (174.30 kg/ha). The experiment consists of 18 treatment combinations with two methods of cultivation (M_1: SRI method and M_2: conventional method of planting), three rice hybrids (H_1: KRH-2, H_2: KRH-4 and H_3: Arize (6444)) and three fertility levels (F_1: 100 % RDF, F_2:125 % RDF and F_3: 150 % RDF) were tested in split-split plot design replicated thrice assigning methods of cultivation in main plots, rice hybrids in sub-plots and fertility levels in sub- sub plots. Fourteen days and twenty one days old seedlings of rice hybrids were transplanted with a spacing of 25 x 25cm and 20x 10cm in SRI and conventional method of planting respectively. The recommended dose of fertilizers (125:62.5:62.5 kg NPK ha^{-1}, respectively) were applied as per the treatments indicated in the plan. Full dose of phosphorus, 50% nitrogen and 50% potassium were applied as basal dose at the time of

transplanting and the remaining 50% nitrogen was applied in two equal splits at 30 DAT and at panicle initiation and the remaining 50% potassium was applied at 60 DAT as top dressing. All other recommended agronomic practices and plant protection measures were adopted to raise the crop. Observations on growth parameters, yield components and productivity of rice hybrids were recorded. All the bio-metric data recorded were analyzed statistically as per the procedure prescribed for split-split design (Gomez and Gomez, 1984).

Results and Discussion

Method of establishment: The pooled data indicated that plant height, number of leaves, number of tillers per plant and leaf area per plant differed significantly in both the seasons of study (Table 1). Among the methods of planting, SRI method of planting recorded significantly taller plants (117.83 cm) , more number of leaves (61.66 plant^{-1}), more number of tillers (32.19 tillers plant^{-1}) and higher leaf area (3044.20 cm^2 plant^{-1}) compared to conventional method of planting. Higher

Table 1. Growth parameters of rice hybrids as influenced by different methods of cultivation and fertility levels

Treatment	Plant height (cm)			No. of tillers plant^{-1}			No. of leaves plant^{-1}			Leaf area (cm^2 plant^{-1})			Dry matter production (g plant^{-1})		
	Rainy	Summer	Mean	Rainy	Summer	Mean	Rainy	Summer	Mean	Rainy	Summer	Mean	Rainy	Summer	Mean
Main plot: Methods of cultivation (M)															
M_1: SRI method	117.25	118.41	117.83	32.86	31.52	32.19	53.98	69.34	61.66	3010.87	3077.54	3044.20	151.52	76.49	75.76
M_2: Conventional method	112.78	113.53	113.15	25.52	27.01	26.26	40.53	56.94	48.73	2199.95	2385.13	2292.54	91.23	47.86	45.62
S.Em±	0.07	0.43	0.25	0.03	0.46	0.25	0.06	0.26	0.16	3.57	42.40	22.98	0.65	0.58	0.32
CD (P=0.05)	0.41	2.63	1.52	0.19	2.78	1.49	0.37	1.59	0.98	21.69	258.02	139.85	3.94	3.50	1.97
Sub plot: Hybrids (H)															
H_1: KRH-2	115.23	116.44	115.83	26.46	26.10	26.28	45.11	60.41	52.76	2470.69	2576.24	2523.46	109.94	57.73	54.97
H_2: KRH-4	119.49	120.15	119.82	28.65	29.81	29.23	46.94	63.24	55.09	2501.91	2679.69	2590.80	123.21	62.80	61.60
H_3: Arize-6444	110.33	111.31	110.82	32.46	31.88	32.17	49.71	65.78	57.74	2843.63	2938.07	2890.85	130.99	66.00	65.49
S.Em±	0.09	0.55	0.32	0.14	0.16	0.15	0.12	0.53	0.33	11.92	15.84	13.88	1.50	0.84	0.75
CD (P=0.05)	0.29	1.80	1.05	0.45	0.51	0.48	0.39	1.73	1.06	38.86	51.66	45.26	4.90	2.75	2.45
Sub Sub plots: Fertility levels (F)															
F_1: 100% Rec. NPK	112.27	113.38	112.83	26.25	27.32	26.79	42.87	58.31	50.59	2304.37	2437.70	2371.03	109.97	56.86	54.98
F_2: 125% Rec. NPK	114.94	116.14	115.54	29.38	29.38	29.38	47.69	62.69	55.19	2602.91	2741.80	2672.35	122.44	62.73	61.22
F_3: 150% Rec. NPK	117.84	118.39	118.11	31.93	31.09	31.51	51.20	68.43	59.81	2908.96	3014.51	2961.73	131.72	66.94	65.86
S.Em±	0.18	0.35	0.27	0.18	0.20	0.19	0.11	0.50	0.31	11.15	41.32	26.23	1.28	0.78	0.64
CD (P=0.05)	0.52	1.01	0.77	0.54	0.57	0.56	0.57	1.47	1.02	32.56	120.61	76.58	3.74	2.27	1.87
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: NS-Not Significant

leaf area might be due to more number of leaves and tillers. SRI method of planting recorded significantly higher dry matter production (75.76 g plant^{-1}). Difference in growth parameters by different methods of establishment was reported by Belder *et al.* (2004).

Significantly higher number of panicles m^{-2} for 2010 and 2011 (334.59 and 349.37 respectively) was observed under SRI method of planting compared to conventional method(Table 2). SRI method of planting recorded significantly higher panicle weight (649.41 and 662.44 g m^{-2}). In both the seasons. Plant height, number of leaves, total tillers per plant, leaf area, dry matter production, number of panicles m^{-2} and panicle weight g m^{-2} contributed for higher grain yield under SRI method of planting (7669 and 7765 kg ha^{-1}). The increase in grain yield in SRI method of planting was attributed to large root volume, profuse tillers with big panicles, more number of panicles with higher grain weight (Satyanarayana and Babu, 2004) and similar trend of result was also observed by Thakur *et al.* (2008).

Effect of rice hybrids: Rice hybrids differed significantly with response to treatments in growth, yield and yield attributes (Table 1). Among rice hybrids, KRH-4 recorded significantly taller plants (119.82 cm). Number of leaves (57.74 plant^{-1}), leaf area (2890.85 cm^2 plant^{-1}) and the production of total tillers (32.17) were more in Arize (6444) rice hybrid resulting in higher total dry matter production (65.49 g/hill). Arize (6444) produced higher number of panicles m^{-2} (342.17 and 345.89) and panicle weight g m^{-2} (693.56 and 697 in 2010 and 2011 respectively) and found superior to KRH-4 and KRH-2 (Table 2).

Significantly higher grain and straw yield (7808 and 8864 kg/ha respectively) recorded in Arize (6444) rice hybrid might be due to synchronization of tillers which helps in early emergence of productive panicles and panicle weight was possibly due to better utilization capacity of available nutrients which helped in determining the relatively more yield.

Effect of fertility levels: Plant height, number of leaves, total tillers per plant and leaf area differed significantly due to fertility levels in both the seasons of study (Table 1). Application of 150 % RDF resulted in taller plant height (118.11 cm), more number of tillers per plant (31.51), number of leaves per plant (59.81), leaf area (2961.73 cm^2 plant^{-1}) and dry matter production (65.86 g plant^{-1}) compared to 125% and 100% RDF. The growth characters like plant

Table 2. Yield and yield parameters of rice hybrids as influenced by different methods of cultivation and fertility levels

Treatment	Panicle weight (g m^{-2})			No. of panicles m^{-2}			Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})		
	Rainy	Summer	Mean	Rainy	Summer	Mean	Rainy	Summer	Mean	Rainy	Summer	Mean
Main plot: Methods of cultivation(M)												
M1: SRI method	649.41	662.44	655.93	334.59	349.37	341.98	7669	7765	7717	8494	8614	8554
M2: Conventional method	594.11	600.74	597.43	301.56	320.74	311.15	7304	7358	7331	8177	8163	8170
S.Em±	5.70	4.38	5.04	5.41	2.41	3.91	19.48	11	15.24	41	40	40.36
CD (P=0.05)	34.70	26.64	30.67	32.90	14.66	23.78	119	64	91.25	246	244	246
Sub plot: Hybrids(H)												
H1: KRH-2	575.61	589.72	582.67	305.83	321.06	313.45	7222	7298	7260	7704	7843	7774
H2: KRH-4	596.11	608.06	602.09	306.22	338.22	322.22	7459	7549	7504	8420	8476	8448
H3: Arize-6444	693.56	697.00	695.28	342.17	345.89	344.03	7778	7838	7808	8881	8846	8864
S.Em±	6.20	5.75	5.98	3.01	5.69	4.35	79	39	58.86	106	91	99
CD (P=0.05)	20.22	18.76	19.49	9.82	18.55	14.19	257	126	191.36	346	296	321
Sub sub plots: Fertility levels(F)												
F1: 100% Rec. NPK	561.39	576.00	568.70	273.78	309.00	291.39	7169	7264	7217	7755	7861	7808
F2: 125% Rec. NPK	613.33	623.89	618.61	311.56	337.67	324.62	7498	7572	7535	8345	8398	8372
F3: 150% Rec. NPK	690.56	694.89	692.73	368.89	358.50	363.70	7793	7849	7821	8907	8906	8907
S.Em±	6.27	4.59	5.43	4.80	6.27	5.54	41.91	37	39.46	77.21	62	70
CD (P=0.05)	18.30	13.40	15.85	14.02	18.29	16.16	122.33	107	114.67	225.35	182	204
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: NS-Not Significant

height and dry matter accumulation were responded significantly up to 150 % RDF. Dwivedi *et al.* (2006) reported that application of 200 kg N ha^{-1} was found statistically at par with 150 kg N per hectare. Higher number of panicles m^{-2} (368.89 and 358.5) and panicle weight g m^{-2} (690.56 and 694.89 respectively) were observed at 150 % RDF than 100 and 125 % RDF (Table 2). Better growth and yield attributes in 150 % RDF resulted in significantly higher grain yield (7793 and 7849 kg/ha). This result was in line with Hima Bindu and Subramanian (2008). But the interaction effect among the three hybrids was non significant.

Based on these results, it could be concluded that rice hybrid Arize (6444) grown under system of rice intensification with 150 per cent recommended dose of fertilizer resulted in significantly higher growth and productivity than conventional method of planting.

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