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Original Research Article

Evaluation of Rice Genotypes for Yield Parameters under Low Light Intensity

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A B S T R A C T

To evaluate the yield parameters of different rice genotypes under low light intensity present experiment was conducted at RARS, Karjat during *Kharif* 2017 by *factorial* randomized block design with three replications. The experiment consisted of two factors *viz.* two treatments (T_1-Without shade net and T_2-Shade net condition). Data were collected on Total number of spikelets per panicle, Number of filled spikelets per panicle, Panicle length (cm), 1000 grain weight (g), Grain yield per plant (g), Straw weight per plant (g), Harvest Index (%). Genotype Palghar-2 showed significantly maximum grain yield per plant and harvest index under shade net condition whereas genotype Ratnagiri-4 recorded significantly maximum grain yield per plant and Harvest index under without shade net condition.

Keywords

Rice, Low light intensity, Genotype

Introduction

Rice (*Oryza s ativa* L.) is the staple food of more than half of the world population. It is the most consumed cereal grain in the world, constituting the dietary staple food for more than half of the planets human population. It is cultivated over an area of 161.85 m ha with a production of 483.8 million tonnes (Anonymous, 2017-18). In Konkan region, area under rice was 3.79 lakh/ha, with production 16.10 lakh tons and productivity 42.5 q/ha. (Anonymous 2016-17) Light is the main energy source for plant photosynthesis and is an environmental signal used to trigger growth and structural differentiation in plants. Without light, the net photosynthesis rate shows a negative value because of discharging CO_2 through dark respiration (Chen *et al.,* 2014).

Light intensity is very important component for plant growth, development, survival and crop productivity (Wang *et al.,* 2013). The researchers have been evaluated the effects of variation in light regimes on morphological characteristics, physiological characteristics, yield and quality of agricultural crops because difficult to control light intensity (Wang *et al.,* 2007). Shade has pronounced effect on the growth of rice. It tends to increase plant height, decrease tillers and panicle number hill^{-1}, grains panicle^{-1} and grain yield. Shade stimulates cellular expansion and rapid cell division resulting in increasing leaf length and plant height (Schoch, 1972). It is well grasped that shading is major negative effect of trees on crop growth, which constitute a major obstacle for farmer's adaptation of agro

forestry. To confirm effect of shading on rice growth and gaining more knowledge in this respect.

Materials and Methods

The experiment comprised of sixteen varieties of rice laid out in *factorial* randomized block design with three replications in artificial shading and open condition. The plots were artificially shaded by using 50 per cent shade net. Such that 50 to 60 per cent of natural light was only received by the crop canopy. The shades were erected in the field in the form of tents. The net was fastened tight to the wire which served as a lining connecting the wooden (bamboo) supports all round both at the bottom and top of the supports. The shade constructed leaving one foot height space from the ground open for ventilation. Data were recorded for the yield parameters such as total number of spikelets per panicle, Number of filled spikelets per panicle, Panicle length (cm), 1000 grain weight (g), Grain yield per plant (g), Straw weight per plant (g), Harvest Index (%). Following were the genotype used for the experiment Sahyadri-5, Karjat -5-17-25-29-6, Karjat-8, Karjat -5-10-10-16-13, Karjat-9, Karjat - BM4, Ratnagiri-4, Karjat -6-22-9-14-13, Ratnagiri-5, Karjat -5-8-13-15-7, Palghar-2, Karjat -5-7-10-12-2, Phondaghat-1, Karjat- 7 (Check Variety), Karjat -1-1-12-24-1-13, Swarnaprabha (Check Variety).

Results and Discussions

Significantly higher number of spikelet's per panicle was observed in T_1 than T_2 at harvest stage In case of genotypes, mean total number of spikelet's per panicle differ significantly. Significantly higher total number of spikelet's per panicle (120.88) were observed in Palghar-2 which was at par with Ratnagiri-5, Ratnagiri-4, Karjat-5-10-10-16-13 and Karjat-7over other genotypes. In case of interaction, mean of total number of spikelet's per panicle differs significantly at harvest stage. Palghar-2 showed higher total number of spikelet's in T_1 than others. Among the genotypes in T_2 treatment average number of spikelet's per panicle was 76.61 to be recorded, while genotype Ratnagiri-4 (102.45) recorded higher number of spikelet's than average number of spikelet's per panicle. The maximum reduction was found in Karjat-BM4 (34.0 %) followed by Karjat-5-7-10-12-2 (32.6 %) and the minimum reduction was found in Ratnagiri-4 (9.2 %) followed by Sahyadri-5 (21.4 %) in total number of spikelet's per panicle. Reduction in total number of spikelet's per panicle of rice under shade as compared to without shade net condition was also recorded by Yoshida *et al.,* (1976), Gbadamosi *et al.,* (2014), Venkateswarlu *et al.,* (1977), Nakano, (2000), Voleti *et al.,* (1996), Vergara *et al.,* (1976), Singh *et al.,* (2005), Yang *et al.,* (2011), Patma *et al.,* (1993) and Thangraj and Sivasubramaniam (1990).

Significantly higher number of filled spikelet's per panicle was observed in T_1 than T_2 at harvest stage. In case of genotypes, mean number of filled spikelet's per panicle differ significantly. Significantly higher number of filled spikelet's per panicle (84.64) were observed in Ratnagiri-4 over other genotypes (Table 1).

In case of interaction, mean of number of filled spikelet's per panicle differs significantly at harvest stage. Ratnagiri-4 showed number of filled spikelet's per panicle in T_1 than others. Among the genotypes in T_2 treatment average number of filled spikelet's per panicle was 54.74 to be recorded, while genotype Palghar-2 (57.77) recorded higher number of filled spikelet's than average number of filled spikelet's per

panicle. The maximum reduction was found in Ratnagiri-4 (35.9 %) followed by Sahyadri-5 (18.7 %) and Karjat-9 (18.5 %) and the minimum reduction was found in Karjat-BM4 (3.2 %) followed by Karjat-5-7-10-12-2 (4.7 %) in number of filled spikelet's per panicle. Reduction in number of filled spikelet's per panicle of rice under shade net as compared to without shade net condition was also recorded by Venkateswarlu *et al.*, (1977), Barmudoi *et al.*, (2016), Fageria, (2007), Ahmad *et al.*, (2009), Yang *et al.*, (2011), Venkateswarlu *et al.*, (1977), Cai *et al.*, (1999), Voleti *et al.*, (1996), Vergara *et al.*, (1976) and Thangraj and Sivasubramaniam (1990).

Table.1 Effects of normal light (Without Shade Net) and low light (Shade Net) on total number of spikelet's per panicle and number of filled spikelet's per panicle at harvesting stage of rice (*Oryza sativa* L.)

Genotypes	Total no. of spikelet's per panicle				No. of filled spikelet's per panicle			
	T_1	T_2	Mean	Reduction (%)	T_1	T_2	Mean	Reduction (%)
Sahyadri-5 (G_1)	108.12	84.99	96.55	21.4	70.14	57.04	63.59	18.7
Karjat-8 (G_2)	98.47	69.81	84.14	29.1	57.63	51.99	54.81	9.8
Karjat-9 (G_3)	87.68	68.64	78.16	21.7	56.70	46.23	51.46	18.5
Ratnagiri-4 (G_4)	112.77	102.45	107.61	9.2	84.64	54.26	69.45	35.9
Ratnagiri-5 (G_5)	114.29	88.79	101.54	22.3	73.51	60.29	66.90	18.0
Palghar-2 (G_6)	120.88	83.31	102.10	31.1	69.02	63.76	66.39	7.6
Phondaghat-1 (G_7)	109.45	79.80	94.63	27.1	65.89	57.77	61.83	12.3
Karjat-1-1-12-24-1-13 (G_8)	100.86	71.52	86.19	29.1	59.03	53.19	56.11	9.9
Karjat-5-17-25-29-6 (G_9)	95.33	69.12	82.22	27.5	57.09	50.24	53.66	12.0
Karjat-5-10-10-16-13 (G_{10})	112.72	81.23	96.98	27.9	67.09	59.57	63.33	11.2
Karjat-BM4 (G_{11})	92.06	60.79	76.43	34.0	50.20	48.58	49.39	3.2
Karjat-6-22-9-14-13 (G_{12})	100.17	77.99	89.08	22.1	64.40	52.74	58.57	18.1
Karjat-5-8-13-15-7 (G_{13})	102.51	70.15	86.33	31.6	57.95	54.08	56.02	6.7
Karjat-5-7-10-12-2 (G_{14})	101.07	68.13	84.60	32.6	56.25	53.61	54.93	4.7
Karjat-7 (G_{15})	112.56	76.27	94.41	32.2	62.94	59.54	61.24	5.4
Swarnaprabha (G_{16})	100.24	72.77	86.50	27.4	60.10	52.96	56.53	11.9
Mean	**104.32**	**76.61**			**63.29**	**54.74**		
Factors	**C.D. (5%)**	**S.Em ±**			**C.D. (5%)**	**S.Em±**		
Genotypes	8.730	3.088			5.460	1.932		
Treatment	3.086	1.092			1.931	0.683		
Interaction (G × T)	12.346	4.367			7.722	2.732		

DAT – Days after transplanting T_1 –Without Shade Net T_2 – Shade Net

Table.2 Effects of normal light (Without Shade Net) and low light (Shade Net) on 1000 grain weight (g) and grain yield per plant (g) of rice (*Oryza sativa* L.)

Genotypes	1000 Grain weight (g)				grain yield per plant (g)			
	T_1	T_2	Mean	Reduction (%)	T_1	T_2	Mean	Reduction (%)
Sahyadri-5 (G_1)	26.20	24.36	25.28	7.0	23.33	8.04	15.69	65.5
Karjat-8 (G_2)	13.43	12.04	12.74	10.4	19.71	6.53	13.12	66.8
Karjat-9 (G_3)	19.71	19.32	19.51	2.0	18.35	7.05	12.70	61.5
Ratnagiri-4 (G_4)	26.57	24.70	25.64	7.1	27.71	7.87	17.79	71.5
Ratnagiri-5 (G_5)	12.75	12.49	12.62	2.1	24.41	8.67	16.54	64.4
Palghar-2 (G_6)	12.73	11.94	12.34	6.2	22.46	10.36	16.41	53.8
Phondaghat-1 (G_7)	22.34	20.74	21.54	7.2	18.29	8.50	13.39	53.5
Karjat-1-1-12-24-1-13 (G_8)	24.97	22.37	23.67	10.4	17.59	7.37	12.48	58.1
Karjat-5-17-25-29-6 (G_9)	24.62	20.99	22.80	14.8	17.87	6.97	12.42	61.0
Karjat-5-10-10-16-13 (G_{10})	18.37	16.86	17.62	8.2	20.07	7.37	13.72	63.2
Karjat-BM4 (G_{11})	18.51	18.06	18.29	2.4	14.85	6.07	10.46	59.0
Karjat-6-22-9-14-13 (G_{12})	24.29	21.78	23.04	10.3	18.03	7.58	12.80	57.9
Karjat-5-8-13-15-7 (G_{13})	28.89	25.67	27.28	11.1	16.09	7.93	12.01	50.7
Karjat-5-7-10-12-2 (G_{14})	23.31	21.95	22.63	5.8	16.17	7.52	11.84	53.4
Karjat-7 (G_{15})	24.03	22.89	23.46	4.8	18.51	7.08	12.79	61.7
Swarnaprabha (G_{16})	30.20	26.07	28.14	13.7	18.02	7.43	12.72	58.7
Mean	**21.93**	**20.13**			**19.47**	**7.65**		
Factors	**C.D. (5%)**	**S.Em±**			**C.D. (5%)**	**S.Em ±**		
Genotypes	0.9492	0.3358			1.2229	0.6118		
Treatment	0.3356	0.1187			0.4324	0.2163		
Interaction (G × T)	1.3424	0.4749			1.7294	0.8651		

DAT – Days after transplanting T_1 –Without Shade Net T_2 – Shade Net

The result on effects of normal and low light on 1000 grain weight (g) of rice at harvesting stage is presented in Table 2. As regards treatment it was observed that in the at harvest stage the mean differences in 1000 grain weight were significantly. Significantly maximum 1000 grain weight was observed in T_1 than T_2 at harvest stage. In case of genotypes, mean of 1000 grain weight differs significantly. Significantly maximum 1000 grain weight (30.20 g) was observed in Swarnaprabha over other genotypes. In case of interaction, mean of 1000 grain weight differs significantly at harvest stage. Swarnaprabha showed higher 1000 grain weight in T_1 than others. Among the genotypes in T_2 treatment average 1000 grain weight was 20.13g to be recorded,

while genotype Swarnaprabha (26.07g) recorded higher 1000 grain weight than average 1000 grain weight.

The overall yield reduction percentage was observed maximum in Ratnagiri-4 (71.5%) followed by Karjat-8 (66.8%) whereas; minimum was recorded in Karjat-5-8-13-15-7 (50.7%) as compared to all the tested genotypes.

The maximum reduction was found in Karjat-5-17-25-29-6 (14.8 %) followed by Swarnaprabha (13.7 %) and the minimum reduction was found in Ratnagiri-5 (2.1 %) followed by Karjat-BM4 (2.4 %) in one thousand grain yield. Reduction in one thousand grain yield of rice under shade net as compared to without shade net condition. Such type of results was observed by Prabha *et al.*, (2004), Cai *et al.*, (1999), Stansel *et al.*, (1965), Matsushima *et al.*, (1953), Nayak and Murty (1993), Harmann restrepo and Garses (2013) and Barmudoi *et al.*, (2016).

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The maximum reduction was found in Ratnagiri-4 (71.5 %) followed by Karjat-8 (66.8 %) and the minimum reduction was found in Karjat-5-8-13-15-7 (50.7 %) followed by Karjat-5-7-10-12-2 (53.4 %) in grain yield.

Deng *et al.*, (2014) reported that low light causes impairment of the net photosynthetic rate as well as lower dry matter accumulation and sink capacity in rice plants and these significantly reduces the number of filled grains and 1000 grain weight, thereby leading to decrease grain yield.

Reduction in grain yield of rice under shade as compared to without shade net condition was also recorded by Patma *et al.*, (1993), Singh (2000), Swain *et al.*, (2004) and Singh (2005). Similar results were also reported by Thangaraj *et al.*, (1990), Yoshiba, S. (1981), Murty *et al.*, (1994), Ahmad *et al.*, (2009), Deng *et al.*, (2012), Goto *et al.*, (2009), Barmudoi *et al.*, (2016) and Kobata *et al.*, (2000).

It is concluded that, among the treatments studied, the grain yield per plant was differed significantly under without shade net and shade net condition in all the tested rice genotypes. Therefore, on the basis of overall yield reduction percentage, harvest index and other important traits under shade net, Palghar-2 genotype can be identified as relatively tolerant to light stress. Whereas, genotype Karjat-BM4 most sensitive for the shade net condition or low light tress in all the tested genotypes.

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