Evaluation of different Rice Genotypes under Aerobic Conditions

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Abstract

A field experiment was conducted at Agricultural Research station, Kampasagar, Nalgonda district of Andhra Pradesh during *kharif* 2008-09 to screen rice varieties suitable for aerobic rice cultivation. 12 rice varieties viz., MTU 1001, MTU 1010, JGL 11727, BPT 5204, JGL 384, Tellahamsa, RNRM-7, JGL 3844, Erramallelu, JGL 1798, JGL 3828 and JGL 3855 were evaluated in a randomized block design with three replications. The rice variety JGL 11727 produced the highest grain yield of 6.18 q $ha^{-1}$and it was significantly superior to other rice varieties except JGL 3855 which produced on par grain yield (6.16 q ha^{-1}). The next best variety was MTU 1010 (5.33 q ha^{-1}) and was on par with JGL 1798 (5.21 q ha^{-1}), JGL 384 (5.18 q ha^{-1}) and RNRM-7 (5.00 q ha^{-1}). The combined amount of effective rainfall and irrigation water from sowing to harvest varied from 775 to 900 mm. The variety JGL 11727 with duration of 130 days registered the highest water use efficiency of 7.3 kg rice ha^{-1} mm of water. Tellahamsa, which matured in 115 days, recorded the lowest water use efficiency of 3.5 kg of rice ha^{-1} mm of water. The second best variety was JGL 3855 (7.1 kg ha^{-1} mm^{-1}). Highest BC ratio of 2.0 was recorded in JGL 11727 and JGL 3855 followed by BPT 5204 and JGL 1798 (1.7). Lowest BC ratio was obtained in Tellahamsa.

1. Introduction

In India, rice is grown in an area of 42.4 m ha with a production of 88.2 million tonnes. It is estimated that demand for rice in 2030 will be 121 million tonnes (CRRI, 2011). Rice deserves a special status among cereals as world's most important wetland crop. This global grain provides 35-80% of total calorie uptake to more than 2.7 billion people (Gorantla et al., 2005). In Andhra Pradesh from 4.0 million ha, 17.8 million tonnes rice was produced during 2010-11. Rice consumes more than 50% of the water used for irrigation in Asia (Barker et al., 1999). The looming global water crisis threatens the sustainability of irrigated rice, which is the Asia's biggest water user. The water requirement for traditional transplanted rice is 1500 mm. It means to produce 3000 kg ha^{-1} grain yield, 1,50,00000 liters of water is required. The application of water for rice production is 5-6 times more than the other crops (wheat and maize). Farmers are submerging the rice fields up to 30 cm depth. This much of water application is not required for rice and moreover applying excess amount of water in long run causes adverse effects on environment and decreases the productivity. In future, available water resources will be depleted due to changes in climate for agriculture especially for rice, so it is necessary to reduce the requirement of water for rice. Keeping these points in view we have to switch over to water saving techniques like aerobic rice cultivation having high water use efficiency. The system of rice cultivation without constant standing water in non puddled soils, referred to as the 'aerobic rice' and is considered to be one of the most promising technologies in terms of water saving (Singh., 2004). In this system, rice is sown directly into dry soil and irrigation is given to keep the soil sufficiently moist for good plant growth, but the soil is never flooded (Bouman, 2001).

Aerobic rice production system is gaining importance for increased productivity and to reduce water requirement. Further, it is expected to occupy 7.1 m ha of the total area in India. To make aerobic rice successful, suitable variety should be identified. Hence, the present investigation was carried out to find the suitable variety for aerobic rice production.

2. Materials and Methods

A field experiment was conducted during *kharif* season of 2008 at Agricultural Research Station, Kampasagar, Nalgonda district of Andhra Pradesh, India. The soil of the experimental site was sandy clay loam with pH 8.1. The nutrient status

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was medium in available N (281.9 kg N ha^{-1}) and available phosphorous (22.62 kg P_2O_5 ha^{-1}) and high in available potassium (335.7 kg K_2O ha^{-1}). Twelve rice varieties viz., MTU 1001, MTU 1010, JGL 11727, BPT 5204, JGL 384, Tellahamsa, RNRM -7, JGL 3844, Erramallelu, JGL 1798, JGL 3828 and JGL 3855 were evaluated in randomized block design with three replications. The field was thoroughly prepared by using tractor drawn disc plough, cultivator and rotavator. The seeds were soaked in water for 12 hours and incubated for 10 hours. Sprouted seeds were line sown with a spacing of 20×5 cm. A common fertilizer dose of 120:60:40 kg N, P, K ha^{-1} was adopted. The entire dose of P and half of the K was applied as a basal dose. Another half of the recommended K was applied at panicle initiation stage. Nitrogen was applied in three equal split doses at basal, active tillering and panicle initiation stages. Pre-emergence herbicide Pendimethalin at 1.0 kg a.i. ha^{-1} was applied at 2 DAS. Hand weeding was done at 20 DAS and 45 DAS. Need based plant protection was given. Irrigation was given with 2.5cm depth of water during the first 30 days and 3.0cm depth of water later by using Parshall Flume. The total rainfall was calculated for the crop growth period.

3. Results and Discussion

3.1. Yield and yield attributes

The number of panicles m^{-2}, panicle length, filled grains $panicle^{-1}$ and 1000 grain weight were significantly influenced by varieties under aerobic condition (Table 1). Among the varieties, JGL 11727 recorded significantly more number of panicles (452 m^{-2}) than other varieties. It was on par with JGL 3855 (401m^{-2}) and MTU 1010 (379 m^{-2}). The lowest number of panicles was observed in Tellahamsa (229 m^{-2}). Significantly longer panicle was observed in JGL 11727 (33.05 cm) than other varieties. The next best variety was JGL 3855 (24.70 cm). It was on par with JGL 1798 (23.40) and MTU 1010 (23.35 cm). The shortest panicle length was observed in Tellahamsa (18.70 cm). In JGL 11727 significantly higher grains $panicle^{-1}$ (245) was recorded. It was on par with JGL 3855 (238), MTU 1010 (225) and JGL 1798 (209). In Tellahamsa least number of grains $panicles^{-1}$ was observed (63). The 1000 grain weight was higher in MTU 1001(35.70) followed by Tellahamsa (30.00). The lowest 1000 grain weight was recorded in RNRM-7 (13.60 g).

The grain yield was significantly influenced by the different rice varieties (Table 1). The panicle number m^{-2}, panicle length and filled grains $panicle^{-1}$ were higher in JGL 11727 which contributed higher grain yield (6180 kg ha^{-1}) than other varieties and it was on par with JGL 3855 (6160 kg ha^{-1}). The grain yield recorded in MTU 1010, JGL 1798, JGL 384 and RNRM-7 were comparable with each other. The lowest grain yield was recorded in Tellahamsa (2700 kg ha^{-1}). The results obtained in the present study corroborate the findings of Valarmathi and Leenakumary (1998) who reported that yield increase in the varieties under direct seeded conditions was mainly due to increase in number of productive tillers.

3.2. Economics

Highest gross and net returns were obtained in JGL 11727 (₹ 55620 and ₹ 28120) followed by JGL 3855 and BPT 5204. Lowest gross returns and negative net returns were obtained in Tellahamsa (₹ 16200 and ₹ -10800). Highest BC ratio of 2.0 was recorded in JGL 11727 and JGL 3855 followed by BPT 5204 and JGL 1798 (1.7). Lowest BC ratio was obtained in Tellahamsa.

3.3. Water use efficiency

The variety JGL 11727 with duration of 130 days registered the highest water use efficiency of 7.3 kg rice ha^{-1} mm of water (Table 2). Tellahamsa, which matured in 115 days, recorded the lowest water use efficiency of 3.5 kg of rice ha^{-1} mm of water. The second best variety was JGL 3855 (7.1 kg ha mm^{-1}). The most salient feature of aerobic rice in our study was the extremely low water input used to realize the reported yields. The combined amount of rainfall and irrigation water from sowing to harvest varied from 775 to 900 mm, compared

Table 1: Grain yield and yield attributes of rice genotypes under aerobic conditions

Treatments (Varieties)	Panicles m^{-2}	Panicle length (cm)	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	1000 grain weight (g)	Grain yield (kg ha^{-1})
MTU 1001	308	19.65	84	8	35.7	3560
MTU 1010	379	23.35	225	13	23.5	5330
JGL 11727	452	33.05	245	26	23.85	6180
BPT 5204	352	20.45	104	12	15.4	4820
JGL 384	359	22.1	150	11	19.8	5180
Tellahamsa	229	18.7	63	8	30	2700
RNRM-7	358	21.25	132	9	13.6	5000
JGL 3844	266	20.2	92	14	24.25	3950
Erramallelu	256	19.65	74	13	23.05	3540
JGL 1798	379	23.4	209	14	22.95	5210
JGL 3828	336	19.8	100	6	23.85	4600
JGL 3855	401	24.7	238	20	22.5	6160
SEm±	43	0.9	18	3	1.22	209
CD (p=0.05)	88	1.8	38	6	2.5	431

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Table 2: Economics of rice genotypes under aerobic conditions

Treatments (Varieties)	Grain yield (kg ha^{-1})	Gross returns (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C Ratio
MTU 1001	3560	28480	27500	980	1.0
MTU 1010	5330	42640	27500	15140	1.5
JGL 11727	6180	55620	27500	28120	2.0
BPT 5204	4820	48200	28000	20200	1.7
JGL 384	5180	46620	27500	19120	1.6
Tellahamsa	2700	16200	27000	-10800	0.6
RNRM-7	5000	35000	26900	8100	1.3
JGL 3844	3950	35550	27500	8050	1.2
Erramal-lelu	3540	24780	27000	-2220	0.9
JGL 1798	5210	46890	27500	19390	1.7
JGL 3828	4600	41400	27500	13900	1.5
JGL 3855	6160	55440	27500	27940	2.0

Table 3: Water use efficiency of different rice varieties under aerobic condition

Treatments (Varieties)	Irriga-tion wa-ter (mm)	Total rain fall (mm)	Total water (mm)	Water use efficiency (kg ha^{-1} mm^{-1})
MTU 1001	370	500	870	4.1
MTU 1010	290	500	790	6.7
JGL 11727	350	500	850	7.3
BPT 5204	400	500	900	5.3
JGL 384	355	500	855	6.0
Tellahamsa	275	500	775	3.5
RNRM-7	345	500	845	5.9
JGL 3844	295	500	795	4.9
Erramallelu	300	500	800	4.4
JGL 1798	300	500	800	6.5
JGL 3828	360	500	860	5.3
JGL 3855	360	500	860	7.1

with 1200-1300mm in lowland rice. Similar findings were reported by Bouman et al. (2002).

3. Conclusion

From this study it is concluded that the rice variety JGL 11727 produced the highest grain yield and registered the highest water use efficiency and BC ratio followed by the JGL 3855 among all the tested varieties under aerobic condition.

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