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IDENTIFICATION ON SUITABLE RICE VARIETY ADAPTABILITY TO AEROBIC IRRIGATION

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ABSTRACT

A field experiment was conducted at Central Farm, Tamil Nadu Agricultural University, Coimbatore to screen suitable rice varieties for aerobic rice cultivation. 12 rice varieties *viz*., ADT 38, ADT 39, ADT 43, ADT 46, CO 43, CO 45, CO 46, CO 47, White Ponni, PMK 3, MDU3 and ADS 16 were evaluated in randomized block design with three replications. The upland rice variety PMK 3 produced the highest grain yield of 3684kg ha^{-1} and it was significantly superior to other rice varieties. The next best variety was ASD 16 (3138kg ha^{-1}) and it was on par with MDU 3 (2943kg ha^{-1}) and CO 43 (2805kg ha^{-1}). The water productivity varied among the varieties depending upon their field duration. The combined amount of effective rainfall and irrigation water from sowing to harvest varied from 520 to 650 mm, compared with 1200-1300mm in lowland rice. The variety PMK 3 with duration of 137 days registered the highest water productivity of 7.06kg rice per ha mm of water. White Ponni, which matured in 184 days, recorded the lowest water productivity of 1.5kg of rice per ha mm of water. The second best variety was ASD 16 (5.79). Compared with lowland rice, water consumption in aerobic rice was lower than 50% and water productivity was 60% higher.

Keywords: rice, aerobic, upland variety.

INTRODUCTION

In Tamil Nadu from 1.4 million ha, 3.2 million tonnes rice was produced with the productivity of 2308kg ha^{-1} during 2003-2004. In India during 2003-2004, 87 million tonnes of rice was produced from an area of 42.41 million ha, with the productivity of 2051kg ha^{-1}. It is estimated that demand for rice in 2010 will be 100 million tonnes and in 2025, it will be 140 million tonnes (Singh, 2004). 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). Rice consumes more than 50 per cent 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. Aerobic rice is a new concept of growing rice in non-puddled and non flooded aerobic soil. 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.

MATERIALS AND METHODS

A field experiment was conducted at Central Farm, Tamil Nadu Agricultural University, Coimbatore to screen suitable rice varieties for aerobic rice cultivation. The field was clay loam in texture, taxonomically known as Typic Haplustalf. The soil was neutral in pH (7.1) and the EC was 3.9 dSm^{-1}. The soil was low (219kg ha^{-1}) in available N, medium (17kg ha^{-1}) in available P and medium (396kg ha^{-1}) in available K. Twelve rice varieties *viz*., ADT 38, ADT 39, ADT 43, ADT 46, CO 43, CO 45, CO 46, CO 47, White Ponni, PMK 3, MDU3 and ADS 16 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 x 5 cm. A common fertilizer dose of 150:50:50 kg N, P, K ha^{-1} was adopted. The entire dose of P was applied as a basal dose. Nitrogen and K fertilizers were applied in four equal split doses at 15 days after sowing (DAS), tillering, panicle initiation and heading stages. Pre-emergence herbicide Pendimethalin at 0.75kg a.i. ha^{-1} was applied at 3 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.

RESULTS AND DISCUSSION

Growth parameters of rice variety (Table-1)

Significant difference in leaf area index (LAI) was observed at flowering stages, the rice variety CO 43 recorded higher LAI (7.45) and it was significantly superior to other rice varieties. This was followed by ADT 46 (6.42) and MDU 3 (6.18). The lowest LAI was recorded in CO 47 (4.12). The root length was significantly influenced by the rice varieties. At flowering stage, the lengthiest root was observed in ADT 39 (19.8 cm) and PMK 3 (19.8cm) and it was on par with ASD 16 (18.7cm). The lowest root length was observed in CO 47 (14.3cm). At flowering stage, CO 45 recorded higher root volume (35.2cc) and it was significantly superior to other rice varieties. The next best variety was ADT 46 (31.7cc). The lowest root volume was observed in ADT 38 (19.3cc). The rice variety PMK 3 recorded higher root DMP (5.54g plant $^{-1}$) which was on par with ASD 16 (5.50g plant $^{-1}$), MDU 3 (5.40g plant $^{-1}$) and CO 45 (5.30g plant $^{-1}$). The lowest root DMP was observed in White Ponni (4.10g plant $^{-1}$).

The total dry matter production (DMP) was significantly influenced by the rice varieties. At flowering stage, the rice variety CO 43 recorded higher DMP (7.02t ha^{-1}) and it was on par with PMK 3 (6.79t ha^{-1}). The next best varieties were MDU 3 (6.52t ha^{-1}) and ASD 16 (6.51t ha^{-1}). The lowest DMP was recorded in White Ponni (4.36t ha^{-1}).

Table-1. Growth attributes of different rice varieties under aerobic irrigation.

Treatments	Leaf area index at flowering	Root length at flowering (cm)	Root volume at flowering (cc)	Root dry weight at flowering (g)	DMP at flowering (t ha^{-1})
ADT 38	2.88	16.6	19.3	4.34	6.56
ADT39	2.75	19.8	31.3	4.84	7.13
ADT 43	3.37	15.9	28.7	3.90	6.20
ADT 46	4.30	17.2	31.7	4.51	6.37
CO 43	4.64	16.8	26.5	5.10	9.87
CO 45	4.52	16.9	35.2	5.30	7.83
CO 46	4.20	15.2	29.3	4.90	8.32
CO 47	2.54	14.3	23.9	4.45	7.20
PONNI	3.20	15.2	19.6	4.10	5.75
PMK 3	4.14	19.8	25.7	5.54	8.95
MDU 3	4.52	15.4	27.5	5.40	7.92
ASD 16	3.26	18.7	25.9	5.50	8.03
CD (P = 0.05)	0.54	1.1	1.7	0.30	0.48

Yield components and yield of rice (Table-2)

The number of panicles per unit area was significantly influenced by the rice variety. Among the rice varieties, PMK 3 recorded higher number of panicles (346 m^{-2}) and it was significantly superior to other rice varieties. The next best treatment was ASD 16 (315 m^{-2}) and it was on par with MDU 3 (309 m^{-2}) and CO 43 (306 m^{-2}). The lowest number of panicles per unit was recorded in White Ponni (186 m^{-2}). Filled grains per panicle were significantly influenced by the rice varieties. Among the rice varieties, a filled grain per panicle was higher in PMK 3 (96.6) and it was on par with ASD 16 (96.1). The rice variety ADT 43 recorded the lowest number of filled grains (48.4) per panicle.

The grain yield was significantly influenced by the different rice varieties. The root length, root dry matter, panicle number per unit area, and filled grains were higher in PMK 3 which contributed to higher grain yield. The variety PMK 3 produced the highest grain yield of 3684kg ha^{-1} and it was significantly superior to other rice varieties. The next best variety was ASD 16 (3138kg ha^{-1}) and it was on par with MDU 3 (2943kg ha^{-1}) and CO 43(2805kg ha^{-1}). The lowest grain yield was recorded in White Ponni (984kg ha^{-1}).

Water productivity (Table-2)

The water productivity varied among the varieties depending upon their field duration. The variety PMK 3 with a duration of 137 days registered the highest water productivity of 7.06kg rice per ha mm of water. White Ponni, which matured in 184 days, recorded the lowest water productivity of 1.5kg of rice per ha mm of water. The second best variety was ASD 16 (5.79).

Table-2. Yield attributes and water productivity of different rice varieties under aerobic irrigation.

Treatments	Panicles m^{-2}	Filled grains panicle $^{-1}$	Grain yield (kg ha^{-1})	Irrigation Water used (mm)	Total water used (mm)	Water productivity (kg rice ha mm^{-1})
ADT 38	193	64.5	1389	503	620	2.24
ADT39	255	89.4	1753	488	605	2.90
ADT 43	294	48.4	1248	432	522	2.39
ADT 46	262	58.4	1321	468	584	2.26
CO 43	306	90.2	2805	526	654	4.29
CO 45	265	78.4	2418	488	605	4.00
CO 46	283	84.9	2755	468	584	4.72

CO 47	256	82.3	2316	468	584	3.96
PONNI	186	57.8	984	526	654	1.51
PMK 3	346	96.6	3684	432	522	7.06
MDU 3	309	76.7	2943	448	542	5.43
ASD 16	315	96.1	3138	448	542	5.79
CD (P = 0.05)	17	5.6	317			

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 470 to 650mm, compared with 1200-1300mm in lowland rice. Similar findings were reported by Bouman *et al*., 2002. Compared with lowland rice, water consumption in aerobic rice was lower than 50 % and water productivity was 60 % higher.

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