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Studies on Response of Varieties and Different Dates of Sowing on Productivity of Aerobic Rice

Ningaraju GK*, Ramachandra N, Shivakumar M, Rajanna P and Krishnamurthy R

College of Agriculture GKVK, UAS, Bangalore, India

Abstract

A field experiment was conducted during rainy seasons of 2011, 2012 and 2013 at Zonal Agricultural Research Station, V. C. Farm, Mandya, Karnataka, to study the effect of varieties and their different dates of sowing on growth and yield of aerobic rice. Aerobic rice is a new method of growing rice characterized by direct seeding condition without standing water. The experiment was laid out in split plot design with three replications and treatment consisting of two dates of sowing (20th and 30th July) assigned in main plots and six varieties (MAS-26, MAS-946, BI-33, KMP-175, KRH-2 and KRH-4 early and medium duration varieties and hybrids) in sub-plots. The results revealed that aerobic rice sown between 20thand 30thof July resulted non-significant differences in all the three years of study. Among varieties/hybrids evaluated, KRH-4 rice hybrid recorded higher plant height (108.77 cm), more tillers/m^2 (79.97 m^2), lower weed dry weight (8.42 g), more panicle number (472 m^{-2}), higher panicle weight (3.50 g), higher grain yield (6209 kg ha^{-1}) and resulting in higher net returns and B:C ratio (Rs. 51516 ha^{-1} and 2.05 respectively) which was on par with KRH -2 and found significantly superior to other varieties/hybrids. The lower yield was recorded in MAS-946-1 (5032 kg ha^{-1}). The higher water productivity was recorded with KRH-4 (54.47 kg ha cm^{-1}) and KRH-2 (53.25 kg ha cm^{-1}) compared to MAS-26 (43.95 kg ha cm^{-1}) and MAS 946-1 (43.71 kg ha cm^{-1}).

Keywords: Aerobic rice; Date of sowing; Varieties; Hybrids; Water productivity; B:C ratio

Introduction

Rice is the most important and extensively grown staple food crop, accounting for 43% of the total food grain in the country. In Karnataka, rice is grown in an area of 12.78 lakh ha with the total production of 50.13 lakh tones and average productivity is 4126 kg ha^{-1} (Anon., 2013). Water is one of the precious natural resource of the world. According to the United Nations Organizations (UNO), water crisis is the major threat for mankind in the 21st century. From the total available water 75% used for rice cultivation. The rice production in India is strongly influenced by the amount and distribution of rainfall. Inadequate rainfall, lack of water harvesting measures and misuse of water for Agriculture have brought down the per capita availability of water by 40-60% in many Asian countries including India. The high requirement of water for rice cultivation is because rice is generally grown under lowland condition. In low land rice fields, seepage and percolation accounts for 50-80% of the total water outflow from the field [1] irrigated rice requires lot of water about 3000 to 5000 liters is used to produce one kg of grain [2]. Since rice is the most water consuming crop, alternative strategies that require less water and produce stabilized production needs immediate attention. Aerobic rice is a new development in water saving technology, where rice is grown like any other upland cereal crop with supplementing irrigation. It is a system of growing high yielding rice in non-puddle and non-flooded aerobic soil [3]. Developing high yielding drought resistant varieties and the optimum date of sowing with good management practices are an important role under limited water situation in aerobic rice production system. Information on suitable rice varieties/hybrids and dates of sowing under unpuddled condition are meager for southern dry zone of Karnataka. Keeping this in view, the present investigation was carried out to identify the promising cultivars and optimum date of sowing for enhancing higher productivity of aerobic rice.

Materials and Methods

Field experiments were conducted at Zonal Agricultural Research Station, V.C. Farm, Mandya, Karnataka, during rainy season of 2011, 2012 and 2013. The soil of the experimental field was red sandy loam in texture, acidic in reaction (pH: 6.74), EC (0.408 dSm^{-1}), medium in available nitrogen (245 kg ha^{-1}), phosphorus (30 kg ha^{-1}), available potassium (170 kg ha^{-1}) and organic carbon content (0.57%). The treatment comprised of twelve treatment combinations, dates of sowing (D_1: 20th July and D_2: 30th July) assigned in main plots and varieties (V_1: MAS-26, V_2: MAS-946, V_3: BI-33, V_4: KMP-175, V_5: KRH-2 and V_6: KRH-4, early and medium duration varieties and hybrids were in sub-plots. The experiment was laid out in split plot design tested with three replications. High yielding early, medium duration rice varieties and hybrids seeds were dibbled in a well prepared leveled soil with 25 cm × 25 cm, thinning and gap filling operations were done at 15 days after sowing and maintained optimum plant population. Pre-emergence herbicide Bensulfuron methyl (0.6%)+pretilachlor (6.6 G) was applied @10^{-1} at 3 DAS using Knapsack sprayer with a spray volume of 500 lt ha^{-1}. Hand weeding with hoe and mechanical weeding with cycle weeder were also carried out to manage weeds. The recommended fertilizers dose of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied in the form of urea, single super phosphate and muriate of potash. At the time of sowing 50% N, K and full dose of P was applied and remaining 50 per cent N was supplemented as top dressing at 30 and 60 DAS and 50 per cent K was applied at panicle initiation stage. Irrigation was provided immediately after sowing to hasten the germination and establishment. Subsequent irrigations were given to maintain moist condition. The observations on growth parameter, yield and yield attributes were recorded and statistically analyzed at 5 per cent level of significance.

***Corresponding author:** Ningaraju GK, Ph. D. Scholar, College of Agriculture GKVK, UAS, Bangalore, India, Tel: 9483337415; E-mail: rajuagron@gmail.com

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The cost of cultivation, net returns and B: C ratios were worked out based on the prevailing local market price.

Results and Discussions

Effect of dates of sowing

The pooled data (3 years) on dates of sowing resulted non-significant differences among the dates of sowing with respect to growth and yield parameters of aerobic rice. However, the higher grain yield (5484 kg ha^{-1}), panicle number (453/m^2), panicle weight (3.17 g), plant height (101.50 cm), more number of tillers/m^2 (78.83/m^2), lower weed dry weight (10.06 g) and days to 50 per cent flowering and maturity (90 and 136 days respectively), and higher grain yield was recorded in aerobic rice sown on 20th July as compared to 30th July.

Response of varieties/hybrids

The rice variety/hybrid had considerable variation in growth, yield performance and water productivity under aerobic situation. Experimental results revealed that among rice varieties/hybrid, KRH-4 recorded significantly higher plant height (108.77 cm), more number of tillers (79.97/m^2) , lower weed number (8/m^2), less weed dry weight (8.42g), more number of days to 50 per cent flowering and maturity (92 and 138 days, respectively) , more panicle number/m^2 (472/m^2), higher panicle weight (3.50g) and intern produced higher grain yield (6168 kg ha^{-1}) which was on par with KRH-2 (5981 kg ha^{-1}) and found significantly superior to other varieties/hybrids in the study. This higher grain yield was might be due to synchronization of tillers which helps in early emergence of panicles, more growth and yield components [4] (Tables 1-3).

Water productivity

The rice varieties/hybrids under the study showed variation in water productivity in all the three seasons. The rice hybrid KRH-4 and KRH-2 were recorded higher water productivity (54.47 kg ha cm-1 and 53.25 kg ha cm^{-1} respectively) and found superior than other varieties. The lower water productivity was observed with variety MAS 946-1 (43.71 kg ha cm^{-1}). The higher water productivity might be due to lower water used and higher grain yield produced by hybrids [5,6].

Profitability of aerobic rice

The economic analysis of aerobic rice differed significantly due o varieties and different dates of sowing .The higher gross returns, net returns and benefit cost ratio were achieved from KRH-4 rice hybrid (Rs. 76,625 ha^{-1}, Rs. 51,516 ha^{-1}, 2.05 respectively) followed by KRH-2 (Rs. 73,688 ha^{-1}, Rs. 48,579 ha^{-1}, 1.93 respectively) and found significantly superior over other varieties in the trial This might be due to more growth, yield components, lower weed infestation and higher grain yield potential of that hybrid. The lower gross, net returns and B: C ratios were observed with MAS-26 varieties under aerobic rice (Rs. 59,528 ha^{-1}, Rs. 35,254 SS, 1.46, respectively). The higher net returns with hybrids might be due to higher grain yield produced. The lower returns may be due to low grain yield produced by varieties (Tables 4 and 5)

Summary

From the study, it may be concluded that rice hybrid KRH – 4 and KRH - 2 sown on 20th July was optimum for obtaining higher grain yield under un-puddled condition performing better than varieties grown under aerobic situation.

Treatments	Plant height at harvest (cm)				Number of tillers/m^2				Test weight (g)
	Kharif 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean	
D_1 : 20th July	102	93.1	109.4	101.50	87.4	81.2	67.9	78.83	21.7
D_2 : 30th July	103	93.7	103.4	100.03	84.8	76.3	67.1	76.07	21.7
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS		NS
V_1 : Early KMP-175	103.2	98	105.1	102.10	85.7	81	68.7	78.47	19.3
V_2 : Early – BI 33	98.7	93.4	108.8	100.30	85	79.6	69.6	78.07	22.2
V_3 : Medium – MAS 26	92.9	80.1	96.8	89.93	91.3	64.9	64	73.40	24.9
V_4 : Medium – MAS 946-1	108.6	84.3	98.7	97.20	85.3	81	62.3	76.20	22.1
V_5 : Medium – KRH-2	99.3	107.9	111.8	106.33	83.6	82	70.4	78.67	22.0
V_6 : Medium – KRH-4	112.5	96.7	117.1	108.77	85.9	83.9	70.1	79.97	19.8
S.Em. (±)	1.32	2.4	0.16	1.29	1.24	1.51	1.83	1.53	0.35
C.D. at 5%	3.86	7.01	0.47	3.78	3.6	4.4	5.36	4.45	1.02

Table 1: Growth components of aerobic rice as influenced by date of sowing and varieties.

Treatments	Weed number/m^2				Weed dry weight (g)				Days to 50% flowering			Days to maturity		
	Kharif 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 13	Mean
D_1: 20th July	9	8	9	9	12.85	11.82	5.51	10.06	91	88	90	139	133	136
D_2: 30th July	9	9	10	9	13.08	12.13	5.49	10.23	88	84	86	131	134	133
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
V_1: Early KMP-175	8	7	8	8	12.58	11.52	5.18	9.76	92	83	88	128	133	131
V_2: Early – BI 33	9	8	10	9	13.75	12.68	5.73	10.72	86	83	85	128	133	131
V_3: Medium – MAS 26	9	9	11	10	14.15	13.18	5.03	10.79	91	85	88	139	133	136
V_4: Medium – MAS 946-1	10	11	10	10	15.02	13.97	5.93	11.64	82	87	85	138	134	136
V_5: Medium – KRH-2	8	7	8	8	11.72	10.88	5.78	9.46	91	87	89	139	134	137
V_6: Medium – KRH-4	7	6	10	8	10.57	9.62	5.07	8.42	93	91	92	140	135	138
S.Em. (±)	0.71	0.71	0.73	0.72	0.33	0.29	0.144	0.25	0.28	0.57	0.43	0.23	0.22	0.23
C.D. at 5%	NS	2.07	NS	2.07	0.99	0.85	0.420	0.75	0.82	1.68	1.25	0.67	0.64	0.66

Table 2: Weed number; weed dry weight, days to 50% flowering and days to maturity of aerobic rice as influenced by date of sowing and varieties.

Treatments	Panicle number/m²				Panicle weight (g)			
	Kharif 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean
D_1: 20th July	572	447	339	453	2.89	2.68	3.93	3.17
D_2: 30th July	540	409	335	428	2.73	2.49	3.81	3.01
C.D. at5%	NS	NS	NS	NS	NS	NS	NS	NS
V_1: Early KMP-175	522	436	340	433	2.65	2.52	4.07	3.08
V_2: Early – BI 33	527	430	334	430	2.65	2.63	3.43	2.90
V_3: Medium – MAS 26	520	443	321	428	2.63	2.38	3.17	2.73
V_4: Medium – MAS 946-1	579	407	316	434	2.95	2.10	3.78	2.94
V_5: Medium – KRH-2	591	451	356	466	3.00	2.75	4.35	3.37
V_6: Medium – KRH-4	597	463	356	472	2.98	3.13	4.40	3.50
S.Em. (±)	12.77	6.63	4.43	7.94	0.10	0.13	0.056	0.10
SC.D. at 5%	36.88	21.24	12.94	23.69	0.30	0.34	0.162	0.27

Table 3: Yield components of aerobic rice as influenced by date of sowing and varieties.

Treatments	Grain yield (kg ha^{-1})				Total water applied (cm)				Water productivity (kg ha cm^{-1})			
	Kharif 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean
D_1: 20th July	5889	5387	5175	5484	102	103	104	103	57.74	52.30	49.76	53.27
D_2: 30th July	5562	5040	4931	5178	110	109	112	110	50.56	46.24	44.03	46.94
C.D. at5%	NS	NS	NS	NS								
V_1: Early KMP-175	5926	5040	4693	5220	102	102	103	102	58.10	49.41	45.56	51.02
V_2: Early – BI 33	5407	5467	4347	5074	103	102	102	102	52.50	53.60	42.62	49.57
V_3: Medium – MAS 26	5360	4773	4427	4853	108	110	114	111	49.63	43.39	38.83	43.95
V_4: Medium – MAS 946-1	5370	4693	4507	4857	109	110	115	111	49.27	42.66	39.19	43.71
V_5: Medium – KRH-2	6130	5760	6053	5981	111	111	115	112	55.23	51.89	52.63	53.25
V_6: Medium – KRH-4	6148	6187	6293	6209	113	113	116	114	54.41	54.75	54.25	54.47
S.Em. (±)	144.64	257.03	121.88	174.52								
C.D. at 5%	417.76	758.30	355.75	510.60								

Table 4: Grain yield and water productivity of aerobic rice as influenced by date of sowing and varieties.

Treatments	Cost of cultivation (Rs. ha^{-1})				Gross returns (Rs. ha^{-1})				Net returns (Rs. ha^{-1})				B:C ratio			
	Kharif 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean	*Kharif* 11	*Kharif* 12	*Kharif* 13	Mean
V_1: Early KMP-175	22952	24434	25435	24274	65779	64512	61478	63923	42827	40078	36043	39649	1.87	1.64	1.42	1.64
V_2: Early – BI 33	22952	24434	25435	24274	60018	69978	56946	62314	37066	45544	31511	38040	1.61	1.86	1.24	1.57
V_3: Medium – MAS 26	22952	24434	25435	24274	59496	61094	57994	59528	36544	36660	32559	35254	1.59	1.50	1.28	1.46
V_4: Medium – MAS 946-1	22952	24434	25435	24274	59607	60070	59042	59573	36655	35636	33607	35299	1.60	1.46	1.32	1.46
V_5: Medium – KRH-2	23952	24938	26437	25109	68043	73728	79294	73688	44091	48790	52857	48579	1.84	1.96	2.00	1.93
V_6: Medium – KRH-4	23952	24938	26437	25109	68243	79194	82438	76625	44291	54256	56001	51516	1.85	2.18	2.12	2.05

Note: The market price of paddy during 2011-12, 2012-13 and 2013-14 was 1110, 1280 and 1310 Rs./quintal, respectively.

Table 5: Economics of aerobic rice as influenced by date of sowing and varieties.

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