



Performance of rice (*Oryza sativa* L.) varieties under aerobic cultivation in mid hills of Himachal Pradesh

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Abstract

Aerobic rice is a method of rice cultivation in which the crop is raised under un-puddle non-saturated aerobic condition with high external inputs with the objective of achieving higher productivity and water use efficiency. A field experiment was conducted during *kharif* 2012 at Malan to standardize seeding time for six promising rice varieties (four high yielding varieties and two locally recommended hybrids) under aerobic conditions. Each variety was sown at three different dates (10, 20 and 30 June). On an average, significantly higher grain yield was recorded when the sowing was done on 20 June though it was at par with 10 June sowing. Among the varieties, on an average hybrid PAC 807 gave significantly highest yield followed by Arize 6129. However, while comparing different combinations of seeding and variety altogether, Arize 6129 gave significantly highest yield when sown on 10 June. Among the HYVs tested, highest yield was recorded from HPR 1068 while HPR 2143 gave lowest yield. The economic indices calculated also showed similar trend with hybrids showing higher values for gross and net return but had lower B:C ratio owing to the higher cost of seed.

Key words: Aerobic rice, date of sowing, variety

Rice (*Oryza sativa* L.) is the most important cereal crop of the country. It is cultivated on an area of 43.42 million hectare with an average productivity of 2279 kg ha⁻¹ (Anonymous 2014a). It is a staple food for majority of the population of Himachal Pradesh where it is cultivated on an area of about 76.34 thousand hectare with productivity of 1736 kg/ha (Anonymous 2014b). Rice is mostly grown under submerged condition which results in very low water use efficiency besides ecological consequences such emission of green house gases. With the global water crisis looming large due to increasing alternate demands for water, it has become imperative to develop technologies that produce rice using lower quantities of water (Bouman 2001). Aerobic rice is water saving rice production system in which the crop is grown in non – puddled aerobic soils under irrigation and high external inputs (Bouman *et al* 2002). This system of rice cultivation saves water by eliminating wetland preparation (water required for puddling) necessary to avoid seepage and percolation and by

reducing evaporation. In this system the crop is frequently irrigated to keep the moisture content between 70 and 100% of water holding capacity throughout the crop growing season. However, to make this technology viable, suitable package of practices need to be developed for various rice growing areas. Considering the above facts, the present investigation was carried out to find out optimum seeding time for different promising varieties of rice for realizing higher yields under aerobic condition.

A field experiment was conducted at the Experimental Farm of Rice and Wheat Research Centre, Malan during *kharif* 2012 to see the performance of different rice varieties grown at different dates of sowing under aerobic conditions. The soil of the experimental site was silty clay loam in texture, acidic in reaction (pH 5.7) with available nitrogen, phosphorus and potassium content of 322 kg/ha, 28.4 kg/ha and 236 kg/ha, respectively. Six varieties (four HYVs *viz.* HPR1156, HPR 1068, HPR 2143 and RP 2421 along with two locally recommended hybrids Arize 6129 and PAC 807)

were sown at three different dates (10, 20 and 30 June). The experiment was laid out in split plot design with dates of sowing in main plot and varieties in sub plot with three replications. The seed was treated with carbendazim (2.5 g/kg seed) and then soaked in water for 10 hours followed by incubation for 12 hours. Seeds were then dibbled in well leveled seedbed at a spacing of 20 cm x 10 cm using a seed rate of 40 kg/ha. Thinning/gap filling was done at 15 days after sowing (DAS) to obtain optimum plant population. To manage the weeds, pre-emergence application of butachlor (1.5 kg/ha) was done at 3 DAS followed by one hand weeding at 40 DAS. The crop was fertilized with recommended dose of fertilizers (90:40:40) with entire dose of phosphorus and potash along with 50% of recommended nitrogen at sowing. Remaining nitrogen was applied in two equal splits at active tillering and panicle initiation stages. Irrigation was applied immediately after sowing to hasten the germination and crop establishment. Subsequent irrigations were provided as and when required so as to maintain the field at near saturation without stagnation. Data were recorded on yield and yield attributes and subjected to analyses of variance with mean comparison at 5% level of significance. The economic indices were worked out based on the prevailing local market prices.

Significantly higher grain yield was recorded when the crop was sown on 20 June. Though, it was at par with the 10 June sowing date. Sowing on 30 June gave significantly lowest yield (Table 1). The results are in conformity with the findings of Naik *et al.* (2015) who also recorded highest yield when the aerobic rice was sown on 18 June with decline in yield with each successive date of sowing. The lowest yield recorded from the last date of sowing (30 June) was due to the lowest number of panicles/m². The reduction in number of productive tillers due to delayed sowing has also been reported by Dawadi and Chaudhary (2013). Amongst the varieties tested significantly highest grain yield was recorded from hybrid PAC 807 followed by hybrid Arize 6129. Amongst the different HYVs evaluated highest yield was obtained from HPR 1068. HPR 2143 gave significantly lower yield, though it was at par with RP 2421. The higher yield of hybrids was mainly due to higher panicle weight. Similar results showing the superiority of hybrids when grown under aerobic conditions have also been reported by Ningaraju *et al.* (2015). The interaction between the dates of sowing and varieties was significant for grain yield (Table 2). At the first date of sowing (10 June), hybrid Arize 6129 resulted in highest yield which was even significantly higher than the grain yield recorded

Table 1. Effect of varieties and date of sowing on the yield attributes, yield and economics of aerobic rice

Treatment	Panicles/m ²	Panicle weight (g)	Grain yield (t/ha)	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
Date of sowing							
10 June	322	1.85	3.93	26653	64540	37887	1.42
20 June	332	1.92	4.16	26653	68855	42202	1.58
30 June	277	1.82	3.33	26653	54315	27662	1.04
CD (P = 0.05)	15.32	NS	0.36	-	-	-	-
Variety							
HPR 1156	329	1.56	3.53	25080	59600	34610	1.38
HPR 1068	305	1.92	3.83	25080	61990	36910	1.47
HPR 2143	262	1.89	3.32	25080	53335	28255	1.13
RP 2421	346	1.54	3.53	25080	60140	35060	1.40
ARIZE 6129	299	2.11	4.19	29800	68945	39145	1.31
PAC 807	321	2.16	4.45	29800	71450	41650	1.40
LSD (P = 0.05)	17.36	0.18	0.23	-	-	-	-

Table 2. Interaction effect of date of sowing and variety on yield of aerobic rice

Variety	Date of sowing			Mean
	10 June	20 June	30 June	
HPR 1156	2.97	4.11	3.51	3.53
HPR 1068	4.04	4.16	3.28	3.83
HPR 2143	3.07	3.53	3.36	3.32
RP 2421	3.80	4.09	2.68	3.53
ARIZE 6129	5.36	4.48	2.73	4.19
PAC 807	4.36	4.58	4.42	4.45
Mean	3.93	4.16	3.33	
LSD (P = 0.05)				
Date at same or different variety				0.40
Variety at same date				0.44

from all other varieties tested. However, this variety showed a decline in yield with each subsequent date of sowing with significantly lowest yield recorded when the crop was sown on 30 June. This was probably due to the long duration nature of this variety with yields reduced due to exposure to low temperatures at the time of grain filling and maturity in later dates of sowing. Contrary to this

hybrid PAC 807, which is a short duration hybrid, gave yields that were at par at all three dates of sowing with highest yield recorded from 20 June sowing. The HYVs also behaved in a similar manner with all the HYVs giving higher yields when sown on 20 June as compared to other two dates of sowing.

The economic indices calculated for various treatments have been given in Table 1. The gross return as well as net return followed the same trend as that of the grain yield with highest values recorded from hybrid PAC followed by Arize 6129. HPR 1068 gave highest values amongst the HYVs. However B:C ratio showed a different trend with highest value recorded from HPR 1068 (1.47) with hybrids showing lower values. This lower value in hybrids was due to the higher cost of seed which resulted in higher cost of cultivation for these varieties. Amongst the different dates of sowing, 20 June sowing gave highest gross return, net return and B:C ratio while lowest values for all these indices was recorded when the crop was sown on 30 June.

From the above study it can be concluded that in general 20 June is the best time for sowing of aerobic rice. Sowing later than this date should be avoided. Also both the recommended hybrids (PAC 807 and Arize 6129) gave higher yield under aerobic conditions while HPR 1068 proved to be better amongst the HYVs tested. If the farmers are to use hybrid Arize 6129, its sowing should not be delayed beyond 10 June.

References

- Anonymous 2014a. Agricultural Statistics. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.
- Anonymous 2014b. Statistical Year Book of Himachal Pradesh. Department of Economics and Statistics, Government of Himachal Pradesh, Shimla. pp 68-70.
- Bouman BAM 2001. Water - efficient management strategies in rice production. *Int. Rice Res. Notes* 16: 17 – 22.
- Bouman BAM, Wang HQ, Yang XG, Zhao JF and Wang CG 2002. Aerobic rice (Han Dao): A new way of growing rice in water-short areas. In: Proceedings of the 12th International Soil Conservation Organization Conference, Beijing, China 26–31 May 2002. pp 175 – 181.
- Dawadi KP and Chaudhary NK 2013. Effect of sowing dates and varieties on yield and yield attributes of direct seeded rice in Chitwan, Nepal. *Int. J. Agric. Sci. Res.* 2(4): 95 – 102.
- Ningaraju GK, Ramachandra N, Shivakumar M, Rajanna P and Krishnamurthy R 2015. Studies on response of varieties and different dates of sowing on productivity of aerobic rice. *J. Rice Res.* 3: 142.
- Naik BB, Reddy DR, Sreenivas G and Rani PL 2015. Yield and water productivity of aerobic rice (*Oryza sativa* L.) as influenced by dates of sowing and varieties during *kharif* season. *J. Rice Res.* 8(1): 52 – 56.