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Effect of nitrogen levels and weed management practices on growth, yield and uptake of rice under aerobic conditions

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Abstract
A field experiment was conducted during *kharif* season of 2010 at Birsa Agricultural University, Ranchi, to find out the effect of nitrogen levels and weed management practices on the performance of aerobic rice. The experiment was laid out in split plot design with three replications and three nitrogen levels in three main plots, while seven weed control methods in sub-plots. Application of 125kg N/ha gave significantly higher plant height (88.89 cm), tillers/m^2 (288), panicles/m^2 (266), grains/panicle (95.41), 1000 grain weight (23.72 g), grain yield (38.98 q/ha), straw yield (57.78 q/ha), nitrogen, phosphorus and potassium uptake which ultimately resulted in significantly higher net return (`29496/ha) in aerobic rice. However, it was statistically at par with 100 kg N/ha. Among the weed management practices, application of Dhaincha in between rice row+ Pendimethalin P.E. @ 0.75 kg a.i./ha + 2,4-D @ 0.8 kg a.i./ha at 25 DAS produced significantly maximum plant height (92.3 cm), tillers/m^2 (300), panicles/m^2 (295), filled spiklets/panicle (98.13), 1000 grain weight (23.96 g), grain (43.73 q/ha), straw yield (61.68 q/ha), nitrogen, phosphorus and potassium uptake as well as net return (`34405/ha) and B:C Ratio (2.22) in aerobic rice.

Keywords: Aerobic rice, Nitrogen levels, Productivity, Weed management

Introduction
Rice is the staple food for about 50 per cent of the world's population that lives in Asia. India has the largest area under rice cultivation of about 43.46 m ha with production level of 91.79 m t. (DRR, 2011) [1]. Recently, there is an increasing scarcity of fresh water for agriculture particularly for rice cultivation due to declining water levels and to meet on the demand of water to industries and other sectors which threatens the sustainability of irrigated rice ecosystem. In this context a new system of rice growing, "Aerobic culture" is gaining more importance aerobic rice in the present scenario. In cultivation the field remains unsaturated throughout the season like an upland irrigated dry crop. This method of growing rice saves water by eliminating continuous seepage and percolation.

Weeds are the greatest threat to aerobic rice cultivation, resulting in yield losses of 65 % to 92%. (Naresh *et al.,* 2011) [5]. Thus successful aerobic rice culture will largely depend upon the efficient weed control measure. The large scale use of herbicides causes environmental pollution and induces the proliferation of resistant weed biotypes. Which prompt research on environment friendly, low volume and labour efficient methods of weed control for aerobic rice. Sharma *et al.* (2007) [10] noticed increase in yield of DSR with increase in nitrogen rates. However, effect of differential rates of nitrogen on weed management in direct seeded rice is still a matter of debate Jharkhand is having substantial area under rainfed/semi-dry rice offering a vast scope of growing rice under aerobic conditions. In this backdrop, the present study was undertaken with the objectives to determine the effect of nitrogen levels and weed control methods on growth, yield attributes, yield, nutrient uptake and economics of aerobic rice.

Materials and Methods
A field experiment was conducted during *kharif* season of 2010 at Birsa Agricultural University, Ranchi, Jharkhand. The soil of experimental plot was sandy clay loam in texture, with slightly acidic reaction (pH 6.2), low in organic carbon (4.6 g/kg) and available nitrogen (228 kg/ha), high in available phosphorus (35.3 kg P_2O_5/ha) and medium in available potassium (157.1 kg K_2O/ha). The experiment was laid out in split-plot design with three replications with three nitrogen levels [N_1: 75, N_2: 100 and N_3: 125 kg N/ha] randomly allotted in main plots, while seven weed control methods [W_1: Dhaincha in between rice rows +

Pendimethalin (PE) @ 0.75 kg a.i./ha, W_2: Rice + Pendimethalin (PE) @ 0.75 kg a.i./ha, W_3: Dhaincha in between rice rows + Pendimethalin (PE) @ 0.75 kg a.i./ha + 2, 4-D (0.8 kg a.i./ha) at 25 DAS, W_4: Urdbean in between rice rows + Pendimethalin (PE) @ 0.75 kg a.i. /ha, W_5:Urdbean in between rice rows + Pendimethalin (PE) @ 0.75 kg a.i./ha + 2, 4-D (0.8 kg a.i./ha) at 25 DAS, W_6: Weed free check and W_7: Unweeded check] were randomly allotted in sub-plots. Seeds of Dhaincha (*Sesbania aculeata*) were sown in between the rice furrow (1:1 ratio) of 50 kg seed/ha. The selective herbicide 2, 4-D was used for killing Sesbania at 25 days after sowing. The herbicides were sprayed uniformly with Knapsack sprayer fitted with flat fan nozzle calibrated to deliver 500 l/ha water volume. The rice variety Naveen was grown as the test crop. At row spacing of 20 cm. As uniform dose of P_2O_5 and K_2O @ 40 and 20 kg/ha, respectively were applied as basal application. The application of nitrogen was done as per treatment which was applied in three splits (50% as basal, 25% N at active tillering and 25% N at panicle initiation stage). The data on yield attributes and yield of rice were recorded at the time of harvesting. The plant samples collected at harvest were dried at 70ºC, powdered in Willey mill and digested to analyze the various nutrient compositions. The nitrogen, phosphorus and potassium content in plant parts were estimated by Kessler's reagent method (Nicholas and Nason, 1957) [6], HNO_3:$HClO_4$ (9:4) digestion, colour development by Vandomolybdate solution followed by spectrophotometer determination (Jackson, 1973) [2] and flame photometric determination after digestion in HNO_3:$HClO_4$ (9:4) (Jackson, 1973) [2], respectively. The nutrient uptake was estimated by multiplying the nutrient concentration with the grain and straw yield. The economics was computed on the basis of prevailing market rates of produce and agro-inputs. Net return was the difference between the gross returns and total cost of cultivation. The benefit: cost ratio was calculated with dividing the net returns by the cost of cultivation.

Results and Discussion

Growth and yield parameters

The graded nitrogen levels significantly influenced growth and yield attributes of aerobic rice. The highest plant height (88.89 cm), tillers/m^2 (288), panicles/m^2 (266), grains/panicle (95.41) and 1000 grain weight (23.72 g) were recorded with application of 125 kg N/ha (Table 1), which showed its significant superiority over 75 kg N/ha application but, failed to cause significant variation with nitrogen level of 100 kg N/ha. The growth and yield parameters of aerobic rice were also significantly influenced by weed control measure as the highest plant height (92.30 cm), tillers/m^2 (300), panicles/m^2 (295), grains/panicle (98.13) and 1000 grain weight (23.96 g) were recorded with Dhaincha in between rice row + Pendimethalin @ 0.75 kg a.i./ha as pre-emergence + 2, 4-D @ 0.8 kg a.i./ha at 25 DAS, which was similar to Dhaincha in between rice row + Pendimethalin @ 0.75 kg a.i./ha as pre-emergence but, significantly higher than other treatments. The lowest plant height (80.50 cm), tillers/m^2 (218), panicles/m^2 (192) grains/panicle (80.47) and 1000 grain weight (23.18 g) were recorded from unweeded control. This was in conformity with the findings of Jana (2012) [3] and Singh *et al.* (2008) [12].

Grain and straw yield

The grain and straw yield of aerobic rice were significantly affected by nitrogen levels (Table 2). The variety Naveen recorded significantly higher grain (38.98 q/ha) and straw yield (57.78 q/ha) with application of 125 Kg N/ha than lower nitrogen levels of 100 and 75 kg N/ha. The harvest index decrease with the increment in nitrogen level and application of lower nitrogen level i.e. 75 kg /ha gave significantly higher harvest index over 100 and 125 kg N/ha application. It was also accordance with Singh *et al.*, 2014 [11]. Among the weed control practice, Dhaincha in between rice rows + Pendimethalin @ 0.75 kg a.i./ha as pre-emergence + 2, 4-D @ 0.8 kg a.i./ha applied at 25 DAS recorded significantly higher grain, and straw yield of 43.73 and 61.68 q/ha, respectively than other weed management practices except with Dhaincha in between rice rows + Pendimethalin @ 0.75 kg a.i./ha as pre-emergence. The green manure crop Dhaincha accumulated 80-86 kg N/ha in pure stand and 58-79 kg N/ha when intercropped with direct seeded rice in alternate rows Sharma and Ghosh (2000) [9]. Smothering effect and finally resulted in higher grain and straw yield of rice. Similar observations were recorded by Seema *et al.* 2014 [8].

Nutrient uptake

Application of 125 kg N/ha recorded significantly higher nitrogen, phosphorus and potassium uptake by grain and straw as compared to its lower nitrogen level of 75 and 100 kg N/ha application which could be ascribed to better vegetative and reproductive growth thereby producing higher grain and straw yield at higher nitrogen levels i.e. 125 kg N/ha. Since uptake of a nutrient is a function of concentration of nutrient and yield per hectare (Table 3). Among the weed management practice, Dhaincha in between rice row + Pendimethalin @ 0.75kg a.i./ha as pre-emergence +2, 4-D @ 0.8 kg a.i./ha applied at 25 DAS recorded maximum nitrogen, phosphorus and potassium uptake in grain and straw which was significantly higher than rest of the weed management practices except Dhaincha in between rice row +Pendimethalin P.E. @ 0.75Kg a.i./ha. These results are in agreement with the findings of Sinha *et al.* (2005) [13] and Roy and Mishra, (1999) [7].

Soil fertility

Nitrogen levels brought significant improvement in fertility status of soil after harvest, with respect to available nitrogen, phosphorus and potassium content of the soil (Table 4). The available nitrogen, phosphorus and potassium content of the soil improved successively with each increment in nitrogen levels up to 125 kg N/ha indicating significant reserve of nutrients over preceding lower levels. The weed management practices, Dhaincha in between rice row + Pendimethalin P.E. @ 0.75Kga.i./ha +2, 4-D @ 0.8 Kg a.i. /ha at 25 DAS recorded maximum available nitrogen content of the soil which was significantly over all the weed management practices. This might be due to Dhaincha grown as intercrop adds nitrogen to soil which enhances the available nitrogen status of the soil. The available phosphorus content of the soil was higher with Pendimethalin @ 0.75 kg a.i/ha as pre-emergence application while, available potassium content of the soil was significantly higher in unweeded check than other weed control treatments. It was also accordance with Mishra and Singh, 2008 [4].

Economics

Application of 125 kg N/ha gave highest net return (`29496/ha) and benefit: cost ratio (1.93) being at par with 100 kg N/ha. But, both of nitrogen levels recorded significantly higher net return and benefit cost ratio than 75

kg N/ha application (Table 2). Among the weed management practices, Dhaincha in between rice row+ Pendimethalin @ 0.75 kg a.i./ha as pre-emergence + 2,4-D @ 0.8 kg a.i./ha at 25 DAS recorded the highest net return (`34405/ha) being at par with Dhainchain between rice rows + Pendimethalin @ 0.75 kg a.i/ha as pre-emergence but, both the treatments had significantly higher net return than other weed control measures. The benefit: cost ratio was recorded highest with Dhaincha in between rice rows + Pendimethalin@ 0.75 kg a.i/ha as pre-emergence which remained at par with Dhaincha in between rice row+ Pendimethalin P.E. @ 0.75 kg a.i./ha + 2,4-D @ 0.8 kg a.i./ha but gave significantly higher benefit: cost ratio than other weed control measures.

Table 1: Effect of nitrogen levels and weed management practices on growth and yield parameters of rice under aerobic conditions.

Treatments	Plant height (cm)	Tillers/m^2	Panicle/m^2	Filled spiklets	Test weight (g)
Nitrogen levels (kg/ha)					
75	82.43	265	234	86.11	23.17
100	84.37	279	256	90.53	23.58
125	88.89	288	266	95.41	23.72
SEm±	1.11	4.94	2.45	1.73	0.10
CD(P=0.05)	4.34	19.39	9.63	6.80	0.39
Weed management practices					
Dhaincha in between rice row +Pendimethalin P.E. @ 0.75Kg a.i. /ha	86.97	295	284	96.57	23.95
Rice+Pendimethalin P.E. @ 0.75Kg a.i./ha	83.37	275	227	85.20	23.53
Dhaincha in between rice row + Pendimethalin P.E.@ 0.75Kga.i./ha +2, 4-D @ 0.8 Kg a.i./ha at 25 DAS	92.30	300	295	98.13	23.96
Urdbean in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	83.43	278	253	90.60	23.07
Urdbean in between rice row + Pendimethalin P.E.@ 0.75Kg a.i./ha+ 2,4-D@0.8Kg a.i./ha at 25 DAS	84.03	287	256	91.87	23.46
Weed free check	86.00	290	257	91.97	23.28
Unweeded check	80.50	218	192	80.47	23.18
SEm±	2.35	10.27	8.88	1.76	0.26
CD(P=0.05)	6.73	29.47	25.47	5.06	0.79

Table 2: Effect of nitrogen levels and weed management practices on grain, straw, harvest index and economics of aerobic rice

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Net return(`/ha)	B:C ratio
Nitrogen levels (kg/ha)					
75	35.34	49.97	41.29	25682	1.75
100	37.44	55.24	40.22	28002	1.87
125	38.98	57.78	40.13	29496	1.93
SEm±	0.28	0.51	0.11	329	0.02
CD(P=0.05)	1.11	2.00	0.41	1291	0.08
Weed management practices					
Dhaincha in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	43.01	59.88	41.84	33928	2.25
Rice+Pendimethalin P.E. @ 0.75Kg a.i./ha	34.17	49.58	40.77	24951	1.76
Dhaincha in between rice row + Pendimethalin P.E.@ 0.75Kga.i./ha +2, 4-D @ 0.8 Kg a.i./ha at 25 DAS	43.73	61.68	41.52	34405	2.22
Urdbean in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	37.34	53.38	41.23	27011	1.72
Urdbean in between rice row + Pendimethalin P.E.@ 0.75Kg a.i./ha+ 2,4-D@0.8Kg a.i./ha at 25 DAS	37.83	54.14	41.12	27151	1.69
Weed free check	39.40	59.68	39.77	30074	1.97
Unweeded check	25.28	41.98	37.57	16570	1.28
SEm±	1.04	1.27	0.46	1140	0.08
CD(P=0.05)	2.98	3.65	1.31	3271	0.22

Table 3: Effect of nitrogen levels and weed management practices on nutrient uptake of aerobic rice

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw
Nitrogen levels (kg/ha)						
75	49.05 (1.39)	25.43 (0.50)	9.43 (0.266)	3.80 (0.075)	9.02 (0.253)	61.94 (1.236)
100	53.24 (1.42)	30.06 (0.54)	10.11 (0.270)	4.39 (0.079)	10.04 (0.266)	69.34 (1.251)
125	56.66 (1.45)	33.17 (0.57)	10.67 (0.273)	4.62 (0.079)	10.53 (0.269)	73.61 (1.270)

SEm±	0.79	0.49	0.06	0.16	0.34	1.42
CD(P=0.05)	3.10	1.92	0.24	0.65	1.35	5.58
Weed management practices						
Dhaincha in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	61.03 (1.42)	34.91 (0.58)	11.67 (0.271)	5.02 (0.083)	11.80 (0.273)	75.26 (1.253)
Rice+Pendimethalin P.E. @ 0.75Kg a.i./ha	48.35 (1.41)	23.92 (0.48)	9.04 (0.266)	3.62 (0.073)	8.71 (0.253)	61.51 (1.237)
Dhaincha in between rice row + Pendimethalin P.E.@ 0.75Kga.i./ha +2, 4-D @ 0.8 Kg a.i./ha at 25 DAS	64.30 (1.47)	37.62 (0.61)	12.13 (0.276)	5.37 (0.086)	12.14 (0.277)	79.45 (1.283)
Urdbean in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	53.12 (1.42)	26.65 (0.50)	10.08 (0.270)	4.19 (0.078)	9.75 (0.260)	67.67 (1.263)
Urdbean in between rice row + Pendimethalin P.E.@ 0.75Kg a.i./ha+ 2,4-D@0.8Kg a.i./ha at 25 DAS	53.73 (1.42)	29.56 (0.54)	10.40 (0.275)	4.46 (0.082)	10.01 (0.263)	68.54 (1.263)
Weed free check	55.26 (1.40)	35.09 (0.59)	10.48 (0.266)	4.28 (0.072)	10.28 (0.260)	74.25 (1.243)
Unweeded check	35.07 (1.38)	19.12 (0.45)	6.70 (0.265)	2.94 (0.070)	6.36 (0.250)	51.39 (1.223)
SEm±	2.04	1.24	0.30	0.29	0.51	2.75
CD(P=0.05)	5.84	3.56	0.86	0.83	1.46	7.87

Note. Figure in parenthesis indicate per cent nitrogen, phosphorus and potassium

Table 4: Effect of nitrogen levels and weed management practices on Available N, P and K in soil after harvest (kg/ha) of aerobic rice

Treatment	Nitrogen	Phosphorus	Potassium
Nitrogen levels (kg/ha)			
75	224	34.93	156.47
100	227	35.10	156.83
125	229	35.26	157.34
SEm±	0.07	0.00	0.01
CD(P=0.05)	0.26	0.02	0.05
Weed management practices			
Dhaincha in between rice row +Pendimethalin P.E. @ 0.75Kg a.i. /ha	224	34.61	155.93
Rice+Pendimethalin P.E. @ 0.75Kg a.i./ha	231	35.42	157.47
Dhaincha in between rice row + Pendimethalin P.E.@ 0.75Kga.i./ha +2, 4-D @ 0.8 Kg a.i./ha at 25 DAS	232	34.47	155.50
Urdbean in between rice row + Pendimethalin P.E. @ 0.75Kg a.i. /ha	226	35.29	157.27
Urdbean in between rice row + Pendimethalin P.E.@ 0.75Kg a.i./ha+ 2,4-D@0.8Kg a.i./ha at 25 DAS	228	35.32	157.37
Weed free check	226	35.24	157.07
Unweeded check	222	35.30	157.57
SEm±	0.06	0.01	0.01
CD(P=0.05)	0.18	0.02	0.04
Initial value	228.	35.3	157.1

Conclusion

Application of 125 kg N/ha and planting dhaincha in between rice row + pendimethalin P.E. @ 0.75 kg/ha +2, 4-D @ 0.8 kg/ha at 25 days after sowing is the best option for achieving higher productivity and profitability in aerobic rice cultivation.

References

1. DRR, Vision 2030. Directorate of Rice Research, Rajendranagar, Hyderabad, 2011.
2. Jackson ML. Soil Chemical Analysis, Prentice Hall of India Ltd. New Delhi, 1973, 183-04.
3. Jana K. Effect of nitrogen levels and weed management practices on grain yield of aerobic rice cultivation system. Green Farming International Journal of Applied Agricultural & Horticultural Sciences. 2012; 3:670-673
4. Mishra JS, Singh VP. Integrated weed management in dry-seeded irrigated rice (*Oryza sativa*). Indian J. Agronomy. 2008; 53:299-305.
5. Naresh RK, Gupta RK, Singh RV, Singh D, Singh B, Prakesh S *et al*. Promotion of integrated weed management for direct-seeded rice in north west India. *Prog. Agr*. 2011; 11(2):215-232.
6. Nicholas DJD, Nasan. Total nitrogen submicroscopic spectrophotometer method. Methods of Enzymology. 1957; III: 991-93.
7. Roy DK, Mishra SS. Effect of weed management in direct seeded, upland rice (*Oryza sativa*) at varying nitrogen levels. Indian J. Agronomy. 1999; 44:105-108
8. Seema Maya Krishna, Devi M, Thoi Thoi. Effect of nitrogen and weed management on nutrient uptake by weeds under direct seeded aerobic rice. The Bioscan. 2014; 9(2):535-537.
9. Sharma AR, Ghosh A. Effect of green manuring with Sesbania aculeata and nitrogen fertilization on the performance of direct seeded flood prone lowland rice. Nutrient Cycling in Agro-ecosystems. 2000; 57:141-153.
10. Sharma RP, Pathak SK, Singh RC. Effect of nitrogen and weed management in direct-seeded rice (*Oryza sativa*) under upland condition. Indian J. Agron. 2007; 52(3):114-119.
11. Singh Ashwini Kumar, Singh MK, Prasad SK, Sakarwar Pooja. Sequential herbicide application and nitrogen rates effects on weeds in direct seeded rice (*Oryza sativa* L.). *The Ecoscan.* 2014; 8(3, 4):249-252.
12. Singh S, Ladha JK, Gupta RK, Bhushan L, Rao AN. Weed management in aerobic rice systems under varying establishment methods. Crop Protection. 2008; 27:660-

671.
13. Sinha AK, Singh CS, Singh RK, Singh RP. Effect of levels and times of isoproturon alone and in combination with 2, 4-D Na salt in late sown wheat. Crop Research. 2005; 29(1):73-76