International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(6): 1043-1045

Received: 07-09-2019
Accepted: 09-10-2019

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Effect of different nitrogen levels on yield and qualities of red rice cultivars

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Abstract
The experiment was carried out at Instructional cum Research Farm, IGKV, Raipur (C.G.) during *Kharif* season, 2018 to study the different nitrogen levels on qualities of red rice cultivars. The experiment consisted five red rice cultivars (Bantha luchai, Shrikamal, Kankadiya, Khuddi and Jyothi) in main plot and four nitrogen levels (0, 60 kg N ha^{-1}, 80 kg N ha^{-1} and 25 kg N ha^{-1} + LCC based nitrogen management) in sub plot laid out in split plot design with three replications. Maximum grain yield (4.5 t ha^{-1}) was recorded with variety Jyothi fertilized with 80 kg N ha^{-1}. Maximum value for kernel length and breadth before and after cooking was also recorded by variety Jyothi. However Length/Breadth ratio was not influenced significantly by different levels of nitrogen. Hulling per cent, milling per cent and head rice recovery per cent was obtained higher with application of 80 kg N ha^{-1}. Variety Jyothi showed higher alkali value and it was not influenced by different nitrogen levels.

Keywords: Leaf colour chart (LCC), hulling per cent, milling per cent, alkali value

Introduction
Red rice is characterized by a red bran layer in which most of the micronutrients are concentrated. Red rice contains high iron (5.5 mg/100 mg) and zinc (3.3 mg/100 mg). It has high dietary fiber which helps to maintain blood sugar level, lower the cholesterol. It also counters the allergy inducing effect of histamine, great for asthma sufferers. It also has anti-oxidant properties. The zinc and iron content of red rice is two to three times higher than white rice (Ramaiah and Rao, 1953) [5]. Nutrient management plays a key role in yield and quality of crops. Nitrogen is major nutrient which limit the yield potential of rice cultivars. Nitrogen fertilizers applied to soil undergo physical, chemical and biological transformation this ultimately becomes available to crops. Due to various losses and increase in cost, the efficient use of nitrogenous fertilizer is a challenge.

Materials and methods
The experiment was carried out at Instructional cum Research farm, IGKV, Raipur (C.G.) during *Kharif* season, 2018 to study the different nitrogen levels on qualities of red rice cultivars. The experiment was carried out in split plot design with three replications. A combination of five cultivar *viz*., Bantha luchai, Shrikamal, Kankadiya, Khuddi and Jyothi with four nitrogen levels 0, 60 kg N ha^{-1}, 80 kg N ha^{-1} and 25 kg N ha^{-1} + LCC (Leaf colour chart) based nitrogen management was taken in main plot and sub plot respectively. The recommended dose of fertilizer for red rice cultivars was 80 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1}. Full dose of phosphorus and muriate of potash were applied as basal and nitrogen was applied as per treatments in three splits.
The crop from each net plot was harvested separately and grain weight was recorded and expressed in t ha^{-1}. Quality parameters *viz.*, kernel length and breadth before and after cooking, kernel length and breadth ratio before and after cooking, hulling per cent, milling per cent, head rice recovery and alkali value were determined in the laboratory followed standard procedure and formula.

Results and discussion
Grain yield of red rice cultivars were significantly influenced by different nitrogen levels (Table 1). The maximum grain yield was recorded with variety Jyothi (3.92 t ha^{-1}). In case of nitrogen levels, application of 80 kg N ha^{-1} produced significantly higher grain yield (3.38 t ha^{-1}). However, it was statistically at par with 25 kg N ha^{-1} + LCC based nitrogen management

and 60 kg N ha^{-1}. The analysis of variance showed a significant interaction between nitrogen and cultivars that indicate cultivar were influenced with the application of different levels of nitrogen. Hence, variety Jyothi fertilized with 80 kg N ha^{-1} produced higher grain yield (4.50 t ha^{-1}) which was at par with treatment combination of variety Jyothi and 25 kg N ha^{-1} as basal + LCC based nitrogen management, presented in table 1. The reason behind these results might be due genetic characters of variety and application of higher dose of nitrogen.

The data with respect to quality parameters are presented in table 2. The effect of red rice cultivars and nitrogen levels on kernel length and breadth before and after cooking were found significant. Variety Jyothi showed higher kernel length before cooking and higher breadth before and after cooking. Variety Jyothi and cultivar Shrikamal were higher in kernel length after cooking. However, it was statistically at par with Kankadiya and Khuddi. Among different nitrogen levels, the kernel length and breadth was found significant. Significantly higher kernel length and breadth before and after cooking was recorded with application of 80 kg N ha^{-1}. However, it was statistically at par with 60 kg N ha^{-1} and 25 kg N ha^{-1} + LCC based nitrogen management. The high value of kernel length: breadth ratio was recorded with cultivar Bantha luchai (3.03). The kernel length breadth ratio after cooking was influenced significant due to different cultivars. Higher value was observed in Bantha luchai which was statistically at par with Kankadiya. Kernel length: breadth ratio before and after cooking was not significantly influenced due to different nitrogen levels. Hulling and milling per cent was not influenced due to cultivars but significantly affected with different nitrogen levels. Maximum hulling and milling per cent was obtained with application of 80 kg N ha^{-1}. The head rice recovery percentage was significantly higher with cultivar Kankadiya which was statistically at par with all cultivars except variety Jyothi. In case of nitrogen levels, the head rice recovery per cent was higher with application of 80 kg N ha^{-1} which was at par with 60 kg N ha^{-1}. Alkali value was not influenced significantly due to different nitrogen levels. The highest ranking value of alkali spreading was found in variety Jyothi. It might be due to varietal genetic behavior of different red rice cultivars. Nitrogen levels significantly affect the yield and rice quality, Da-wei ZHU *et al.* (2017) [2].

Conclusion

Variety Jyothi recorded higher grain yield and maximum quality parameters among the different red rice cultivars. In case of nitrogen levels, application of 80 kg N ha^{-1} produced significantly higher grain yield. Application of 80 kg N ha^{-1} followed by 25 kg N ha^{-1} + LCC based nitrogen management showed highest value of quality parameters of red rice cultivars. Hulling per cent, milling per cent were not influenced significantly due to cultivars.

Table 1: Interaction effect of red rice cultivars and different nitrogen levels on grain yield of red rice cultivars

Grain yield (t ha^{-1})					
Cultivars	**Nitrogen levels**				
	N_0	**N_{60}**	**N_{80}**	**N_{25}+LCC**	**Mean**
Bantha luchai	2.34	2.93	3.13	2.62	2.76
Shrikamal	2.19	2.86	3.02	3.01	2.77
Kankadiya	2.54	3.01	2.62	3.01	2.80
Khuddi	2.86	3.04	3.64	3.61	3.29
Jyothi	3.21	3.84	4.50	4.13	3.92
Mean	2.63	3.14	3.38	3.28	
			SEm±	CD @ 5%	
Comparison of two main plots			0.15	0.52	
Comparison of two sub plots			0.07	0.21	
Comparison of subplots at same level of main plots			0.31	0.52	
Comparison of main plots at same level of sub plots			0.21	0.66	

Table 2: Effect of nitrogen levels on quality parameters of different red rice cultivars

	Before cooking			**After cooking**						
Treatment	**Kernel length mm**	**Kernel breadth mm**	**Kernel L/B ratio**	**Kernel length mm**	**Kernel breadth mm**	**Kernel L/B ratio**	**Hulling %**	**Milling %**	**Head rice recovery%**	**Alkali value**
Cultivars										
Bantha luchai	5.15	1.70	3.03	9.20	2.81	3.28	75.67	67.67	42.08	5.25
Shrikamal	5.76	1.98	2.94	10.12	3.16	3.20	75.27	68.05	43.26	5.00
Kankadiya	5.51	2.09	2.64	9.96	3.06	3.26	75.98	66.92	44.12	5.50
Khuddi	5.59	2.12	2.64	10.02	3.27	3.07	76.43	66.67	43.07	4.58
Jyothi	6.28	2.42	2.61	10.12	3.67	2.76	75.84	67.19	39.73	7.00
SEm±	0.04	0.02	0.03	0.05	0.02	0.02	0.32	0.59	0.73	0.13
CD at 5%	0.12	0.06	0.09	0.17	0.05	0.07	NS	NS	2.37	0.41
Nitrogen levels										
N_0	5.45	1.98	2.78	9.55	3.12	3.08	72.27	62.57	36.80	5.47
N_{60}	5.63	2.02	2.82	9.83	3.19	3.10	76.41	65.53	43.72	5.67
N_{80}	5.84	2.15	2.74	10.09	3.26	3.11	77.95	72.67	46.04	5.33
N_{25}+LCC	5.71	2.10	2.74	10.06	3.20	3.17	76.72	68.45	43.25	5.40
SEm±	0.04	0.03	0.05	0.04	0.02	0.02	0.29	0.55	0.82	0.13
CD at 5%	0.10	0.09	NS	0.12	0.07	NS	0.83	1.58	2.37	NS

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