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Yield and Quality of Aromatic Rice Influenced by Varied Levels of Nitrogen and Different Weed Management Practices under Aerobic Culture

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ABSTRACT

A field experiment was conducted at S.V. Agricultural College farm, Tirupati for two consecutive seasons of *rabi,* 2009, and 2010 on sandy clay loam soils to study the effect of varied nitrogen and weed management practices on yield and quality parameters of aromatic rice under aerobic culture. The results indicated that highest grain yield and milling percent of rice was realized with application of nitrogen at 140 kg ha^{-1} where as highest straw yield and grain quality parameters *viz*., kernel length, breadth, amylase and protein content of grain was realized with highest level *i.e.* 160 kg N ha^{-1} while the lowest of all these parameters were recorded with 100 kg N ha^{-1}. Among weed management practices, pre emergence application of oxadiargyl @ 75 g ha^{-1} supplemented with hand weeding at 25 DAS recorded the highest grain yield, straw yield, milling percent and protein content of grain. The quality parameters head rice recovery, L: B ratio and volume expansion of rice were not influenced either by nitrogen or weed management practices.

Key words : Aerobic culture, Aromatic rice, Herbicides, Nitrogen response, Quality parameters.

Rice is the staple food in Asia and is the single biggest user of fresh water. It provides 27 per cent of dietary energy and 20 per cent of dietary protein in the developing world, and is the primary source of income and employment for more than 100 million households in Asia and Africa (FAO, 2004). Aerobic rice saves water input and increases water productivity by reducing water losses (seepage, percolation and evaporation) during crop growth. Nitrogen is the most important limiting nutrient and it is necessary to find out the suitable dose of nitrogen fertilizer for the aerobic rice as the system of cultivation is entirely different from traditional low land rice. Early emergence of weeds and their rapid growth result in a sever crop-weed competition for light, nutrients, moisture and space in aerobic rice. With optimum weed control yield of aerobic rice can equal those of transplanted crops (Sipaseuth *et al.* 2000) with saving of precious water and human labour. Hence, the present study was conducted to study the influence of different nitrogen levels and weed management practices on yield and quality of aromatic rice under aerobic culture.

MATERIAL AND METHODS

A field experiment was conducted for two consecutive seasons of *rabi,* 2009, and 2010 at S.V.Agrilcultural College, Tirupati. The soil of the experimental site was sandy clay loam in texture. The experiment was laid out in split plot design replicated thrice. The treatments comprised of four levels of nitrogen *viz.*, 100 kg ha^{-1} (N_1), 120 kg ha^{-1}(N_2), 140 kg ha^{-1}(N_3) and 160 kg ha^{-1} (N_4) assigned to main plots and seven weed management practices *viz.*, Un-weeded check (W_1- Control), PE of pretilachlor @ 500 g a.i ha^{-1} (W_2), PE of oxadiargyl @ 75 g a.i ha^{-1} (W_3), PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1}(W_4), PE of pretilachlor @ 500 g a.i ha^{-1} fb hand weeding at 25 DAS(W_5), PE of oxadiargyl @ 75 g a.i ha^{-1} fb hand weeding at 25 DAS(W_6) and PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} fb hand weeding at 25 DAS(W_7) allotted to sub plots. Recommended dose of 60 and 50 kg ha^{-1} P_2O_5 and k_2O applied basally. The test variety of rice was Sugandha samba(RNR 2465). Grain and straw yields were recorded at harvest. Milling of rough rice was done by Indosaw laboratory miller, kernel length and width was

Table 1. Grain yield (kg ha^{-1}) of aromatic rice as influenced by nitrogen and weed management practices under aerobic culture

Treatments	*rabi*, 2009					*rabi*, 2010				
	100 kg ha^{-1} (N_1)	120 kg ha^{-1} (N_2)	140 kg ha^{-1} (N_3)	160 kg ha^{-1} (N_4)	Mean	100 kg ha^{-1} (N_1)	120 kg ha^{-1} (N_2)	140 kg ha^{-1} (N_3)	160 kg ha^{-1} (N_4)	Mean
Un-weeded check (W_1)	358	427	548	518	463	389	427	608	574	500
PE of pretilachlor @ 500 g a.i ha^{-1} (W_2)	1534	1707	2073	1956	1818	1613	1765	2166	2156	1925
PE of oxadiargyl @ 75 g a.i ha^{-1} (W_3)	1905	2086	2372	2482	2211	1977	2151	2496	2475	2275
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} (W_4)	1881	2063	2349	2465	2189	1907	2068	2421	2407	2201
PE of pretilachlor @ 500 g a.i ha^{-1} fb hand weeding at 25 DAS (W_5)	2088	2452	2824	2701	2517	2162	2515	2895	2791	2591
PE of oxadiargyl @ 75 g a.i ha^{-1} fb hand weeding at 25 DAS (W_6)	2458	2852	3223	3135	2917	2477	2849	3249	3171	2936
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} fb hand weeding at 25 DAS (W_7)	2387	2847	3161	3014	2852	2381	2846	3178	3085	2872
Mean	1802	2062	2364	2324		1844	2089	2431	2380	

	SEm ±	CD (P=0.05)	SEm ±	CD (P=0.05)
Nitrogen (N)	15.25	53	19.75	68
Weed management (W)	27.62	79	26.71	76
N at W	42.80	116	52.41	148
W at N	55.25	157	53.41	152

estimated by using grain vernier (Mitutoyo micrometer), protein content, amylose content and volume expansion of grain was estimated through procedures given by Jackson, 1973, Sadasivam & Manickam (1992) and Shahidullah *et al.* (2009) respectively.

RESULTS AND DISCUSSION

Nitrogen and weed management practices and their interaction significantly influenced the grain yield and the interaction was non significant with regard to straw yield and harvest index. The highest grain yield and net returns (Table 1) were recorded with application of nitrogen 140 kg ha^{-1}, which was at par with 160 kg N ha^{-1}. The highest straw yield (Table 2) was recorded with application of nitrogen 160 kg ha^{-1}, which was at par with 140 kg N ha^{-1}. Application 120 kg N ha^{-1} was next best level, while the lowest grain and straw yields along with lower returns recorded with application of 100 kg N ha^{-1}. The highest harvest index (Table 2) was recorded with application of nitrogen 140 kg N ha^{-1} followed by 160 kg N ha^{-1}, 120 kg N ha^{-1} and the lowest with 100 kg N ha^{-1} with significant disparity between any two of the N levels. Increased N supply would have improved the metabolic activity resulting in increased yield components thus produced higher yields and economic returns of aerobic rice. Higher levels of nitrogen application at 160 kg N ha^{-1} recorded lesser grain yield than 140 kg N ha^{-1} due to the reason that over dose of nitrogen application may have produced excessive tillering which led to competition among them resulting in conversion of lesser number of tillers into effective tillers. These results are in accordance with the findings of Sathiya and Ramesh, (2009).

The highest grain and straw yields along with net returns were recorded with pre-emergence application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS, comparable with PE application of pyrazosulfuron ethyl @ 20g ha^{-1} supplemented with HW at 25 DAS and these in turn superior to PE application of pretilachlor @ 500g ha^{-1} supplemented with HW at 25 DAS. PE application of oxadiargyl @ 75 g ha^{-1} and pyrazosulfuron ethyl @ 20g ha^{-1} alone with out hand weeding were next best treatments, comparable with each other and both of them were significantly higher than pretilachlor @ 500g ha^{-1} alone. Significantly lowest yields were observed with un-weeded check. The highest harvest index was noticed with pre-emergence application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS followed by pyrazosulfuron ethyl @ 20g ha^{-1}, pretilachlor @ 500g ha^{-1} supplemented with HW at 25 DAS and the alone application of these three herbicides, while lowest with un-weeded check with significant difference between any two of them. The reduction in grain yield of aerobic rice due to un-weeded check was 83.6 and 83.2 percent, respectively compared to the best weed management practice *i.e* PE application of oxadiargyl 75 g ha^{-1} or pyrazosulfuron ethyl 20g ha^{-1} supplemented with HW at 25 DAS respectively. The highest yields and economic returns with pre-emergence application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS might be due to higher weed control efficiency during early growth stages of crop, there by competition between crop and weeds for nutrients was minimized and made the crop plants to utilize available nutrients more efficiently through out crop growth period which in turn positively influenced the grain and straw yields and lowest with un-weeded check was due to severe competition offered by weeds for available growth resources through out crop growth period severely affect the yields.

The highest grain yield was recorded with application of 140 kg N ha^{-1} in combination with PE application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS (N_3W_6), which was comparable with N_3W_7 and lowest were recorded with application of nitrogen at 100 and 120 kg ha^{-1} coupled with un-weeded check (N_1W_1 and N_2W_1).These results are in confirmity with the findings of Rajkhowa *et al.* (2005) and Arul Chezhian and Kathiresan, (2008).

Among the quality parameters (Table 3 and Table 4) milling percent and protein content of grain was significantly influenced by both nitrogen and weed management practices, where as kernel length, breadth amylase content was significantly influenced by nitrogen management only. Head rice recovery, L: B ratio and volume expansion ratio was not influenced either by nitrogen or weed management practices tried. Grain quality parameters like kernel length, breadth, amylose and

protein content recorded the highest values with higher level of nitrogen application at 160 kg N ha^{-1}, which was comparable with 140 kg N ha^{-1}. The highest milling percent was recorded with 140 kg N ha^{-1}, which was on par with 160 kg N ha^{-1} These followed by 120 kg N ha^{-1}, while the lowest quality parameters were recorded with 100 kg N ha^{-1}. Among the weed management practices, PE application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS recorded the highest milling per cent and protein content of grain, comparable with PE application of pyrazosulfuron ethyl @ 20g ha^{-1} supplemented with HW at 25 DAS and these in turn superior to PE application of pretilachlor @

Table 2. Straw yield, harvest index and net returns of aromatic rice as influenced by nitrogen and weed management practices under aerobic culture.

Treatments	*rabi*, 2009			*rabi*, 2010		
	Straw yield (kg ha^{-1})	Harvest index	Net returns (Rs ha^{-1})	Straw yield (kg ha^{-1})	Harvest index	Net returns (Rs ha^{-1})
Nitrogen						
100 kg ha^{-1} (N_1)	4231	0.28	36742	4281	0.28	37455
120 kg ha^{-1} (N_2)	4682	0.29	43248	4759	0.29	43596
140 kg ha^{-1} (N_3)	4940	0.31	50870	4995	0.31	52187
160 kg ha^{-1} (N_4)	5023	0.30	49700	5093	0.30	5076
SEm ±	24.40	0.002	394	29.55	0.002	499
CD (P=0.05)	84	0.01	1365	102	0.01	1727
Weed management						
Un-weeded check (W_1)	3643	0.11	3202	3594	0.12	3702
PE of pretilachlor @ 500 g a.i ha^{-1} (W_2)	4630	0.28	37434	4719	0.28	39806
PE of oxadiargyl @ 75 g a.i ha^{-1} (W_3)	4783	0.32	47171	4856	0.32	48446
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} (W_4)	4769	0.31	47031	4841	0.31	47000
PE of pretilachlor @ 500 g a.i ha^{-1} fb hand weeding at 25 DAS (W_5)	4910	0.34	54142	5042	0.34	55716
PE of oxadiargyl @ 75 g a.i ha^{-1} fb hand weeding at 25 DAS (W_6)	5154	0.36	64105	5227	0.36	64244
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} fb hand weeding at 25 DAS (W_7)	5144	0.35	62893	5196	0.35	63082
SEm ±	31.72	0.003	689	41.65	0.003	674
CD (P=0.05)	90	0.01	1958	118	0.01	1916

Table 3. Quality parameters of aromatic rice (milling percent, head rice recovery, kernel length and breadth) as influenced by nitrogen and weed management practices under aerobic culture.

Treatments	*rabi*, 2009				*rabi*, 2010			
	Milling percent	Head rice recovery (%)	Kernel length (mm)	Kernel breadth (mm)	Milling percent	Head rice recovery (%)	Kernel length (mm)	Kernel breadth (mm)
Nitrogen								
100 kg ha^{-1} (N_1)	74.2	67.4	5.47	1.74	74.3	67.6	5.45	1.73
120 kg ha^{-1} (N_2)	75.4	68.2	5.59	1.82	75.6	68.3	5.58	1.79
140 kg ha^{-1} (N_3)	77.4	68.6	5.79	1.90	77.7	68.8	5.80	1.89
160 kg ha^{-1} (N_4)	76.7	68.4	5.84	1.92	77.1	68.6	5.83	1.90
SEm ±	0.31	0.3	0.02	0.01	0.27	0.57	0.03	0.01
CD (P=0.05)	1.1	NS	0.07	0.05	0.9	NS	0.09	0.05
Weed management								
Un-weeded check (W_1)	74.4	67.2	5.65	1.82	74.5	67.4	5.66	1.80
PE of pretilachlor @ 500 g a.i ha^{-1} (W_2)	75.0	67.7	5.66	1.84	75.2	67.9	5.65	1.81
PE of oxadiargyl @ 75 g a.i ha^{-1} (W_3)	75.8	68.2	5.67	1.85	76.1	68.4	5.67	1.82
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} (W_4)	75.6	67.9	5.65	1.83	75.9	68.1	5.66	1.81
PE of pretilachlor @ 500 g a.i ha^{-1} fb hand weeding at 25 DAS (W_5)	76.4	68.4	5.68	1.86	76.7	68.6	5.68	1.84
PE of oxadiargyl @ 75 g a.i ha^{-1} fb hand weeding at 25 DAS (W_6)	77.2	68.8	5.70	1.88	77.5	69.0	5.67	1.85
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} fb hand weeding at 25 DAS (W_7)	77.0	68.5	5.69	1.86	77.3	68.7	5.68	1.83
SEm ±	0.16	0.4	0.02	0.02	0.19	0.51	0.02	0.01
CD (P=0.05)	0.5	NS	NS	NS	0.5	NS	NS	NS

Table 4. Quality parameters of aromatic rice (L: B ratio, amylose, protein content and volume expansion ratio) as influenced by nitrogen and weed management practices under aerobic culture.

Treatments	*rabi*, 2009				*rabi*, 2010			
	L:B ratio	Amylose content (%)	Protein content (%)	Volume expansion ratio	L:B ratio	Amylose content (%)	Protein content (%)	Volume expansion ratio
Nitrogen								
100 kg ha^{-1} (N_1)	3.14	31.67	7.61	1.20	3.16	31.51	7.66	1.19
120 kg ha^{-1} (N_2)	3.07	31.99	8.00	1.26	3.12	32.08	8.04	1.24
140 kg ha^{-1} (N_3)	3.05	32.83	8.37	1.28	3.08	33.07	8.38	1.26
160 kg ha^{-1} (N_4)	3.04	32.62	8.41	1.33	3.08	32.71	8.42	1.30
SEm $\pm$	0.03	0.08	0.09	0.02	0.03	0.14	0.09	0.02
CD (P=0.05)	NS	0.28	0.33	NS	NS	0.48	0.32	NS
Weed management								
Un-weeded check (W_1)	3.11	32.09	7.49	1.24	3.14	32.16	7.43	1.23
PE of pretilachlor @ 500 g a.i ha^{-1} (W_2)	3.08	32.16	7.79	1.26	3.12	32.23	7.78	1.24
PE of oxadiargyl @ 75 g a.i ha^{-1} (W_3)	3.08	32.26	8.05	1.27	3.12	32.33	8.07	1.25
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} (W_4)	3.09	32.21	8.03	1.27	3.13	32.28	8.04	1.25
PE of pretilachlor @ 500 g a.i ha^{-1} fb hand weeding at 25 DAS (W_5)	3.06	32.36	8.29	1.29	3.08	32.42	8.33	1.26
PE of oxadiargyl @ 75 g a.i ha^{-1} fb hand weeding at 25 DAS (W_6)	3.04	32.44	8.55	1.28	3.06	32.51	8.63	1.26
PE of pyrazosulfuron ethyl @ 20g a.i ha^{-1} fb hand weeding at 25 DAS (W_7)	3.06	32.41	8.52	1.27	3.10	32.48	8.6	1.25
SEm $\pm$	0.03	0.09	0.07	0.02	0.02	0.14	0.08	0.01
CD (P=0.05)	NS	NS	0.21	NS	NS	NS	0.23	NS

500g ha^{-1} supplemented with HW at 25 DAS PE application of oxadiargyl @ 75 g ha^{-1} and pyrazosulfuron ethyl @ 20g ha^{-1} alone with out hand weeding were next best treatments, comparable with each other and both of them were significantly higher than pretilachlor @ 500g ha^{-1} alone Significantly lowest values were noticed with un-weeded check Higher protein content of grain with higher levels of nitrogen and PE application of oxadiargyl @ 75 g ha^{-1} supplemented with HW at 25 DAS due to increased absorption of nitrogen by crop in presence of adequate availability of nitrogen and under weed free environment. The protein content of grain is directly proportional to nitrogen uptake by grain. Increased grain protein makes brown rice more resistant to cracking and breakage during abrasive milling. These results are in conformity with those of Ramana murthy, (2010).

The present study concluded that aromatic rice variety sugandha samba can be successfully grown under aerobic culture in Southern Agro-climatic Zone of Andhra Pradesh, with 140 kg N ha^{-1} in combination with either pre emergence application of oxadiargyl @ 75 g ha^{-1} or pyrazosulfuron ethyl @ 20g ha^{-1} supplemented with hand weeding at 25 DAS for higher productivity and quality.

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