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Effect of integrated nutrient management practices on yield, nutrient content and uptake of aerobic rice

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Abstract
The experiment was conducted in the research farm of Indian Institute of Rice Research (IIRR) Rajendranagar, Hyderabad (Telangana) during *kharif* season of 2014. The treatments were consisted of two rice cultivars *viz.* IR-64 and PAC-837 in main plots and four nutrient management viz. 75 per cent RDF, 75 per cent RDF + Biofertilizers (*Azospirillum, PSB, VAM* @ 5 kg ha^{-1}), 100 per cent RDF, 100 per cent RDF + Biofertilizers (*Azospirillum, PSB, VAM* @ 5 kg ha^{-1}) in sub plots. The recommended fertilizer schedule adopted was 120:60:60 kg N, P_2O_5, K_2O ha^{-1} through urea, single super phosphate and muriate of potash. The experiment was laid out in split plot design replicated thrice. The results revealed that PAC-837 obtained significantly higher yield attributes *viz* number of panicles m^{-2}, panicle weight (g) and grain yield as compared to IR-64. As regards to nutrient management, application of 100 per cent RDF + Biofertilizers recorded higher yield, nutrient content and uptake.

Keywords: Biofertilizers, nutrient management, cultivars, aerobic rice

Introduction

Rice (*Oryza sativa* L.) consumes about 90 per cent of the fresh water resources used for agriculture in Asia used for agriculture. The estimated world demand for rice in 2025 is 140 million tones (Singh *et al*., 2004) [9]. More than 90 per cent of world's rice is grown and consumed in Asia, where 60 per cent of the earth's people live**.** A new development in water saving technology is the concept of "aerobic rice". Aerobic rice is a new way of cultivating rice that requires less water than lowland rice. It entails the growing of rice in aerobic soil with the use of external inputs such as supplementary irrigation and fertilizers and aiming at high yields (Wang *et al.*, 2002) [10]. Nutrition is the critical in yield realization of aerobic rice ecosystem. The major consequence of inadequate nutrients is reduced leaf area, thereby limiting light interception, photosynthesis and finally biomass growth, grain yield and water productivity. Nitrogen (N) and phosphorus (P) are very crucial and important nutrients required for rice crop growth and yield. The chemical fertilizer required for producing the crop are costlier and also N and P use efficacy (NPUE) in rice is very low and various methods were tried to increase NPUE but still it is low. Aerobic rice is a new development and relatively less work is done in the fertilizer use and there is need to reduce the cost of fertilizer inputs and increase use efficiency by addition of biofertilizers which are cheaper and also environmentally friendly with this background the study was proposed. To develop cost-effective N and P management strategies. Although, these inorganic fertilizers are supplying major plant nutrients, the application of heavy dose of inorganic fertilizers is not a sound management practice and creates many problems like declining trend in productivity, water pollution, soil degradation etc. It is paramount importance that we have to sweet clover to the other sources of plant nutrients to keep our soil fertile and sustain agricultural production. Hence, emphasis is now being put on the use of nitrogenous fertilizers along with bio-inoculants like *Azotobacter, Azospirillum* etc. (Rawat and Agrawal, 2010) [7]. *Azotobacter* and *Azospirillum* are the most important and well known heterotropic bacteria which increased the yield of several crops by fixing the atmospheric nitrogen in soil (Patil *et al.*, 1976) [6]. Recently Phosphorus solublizing bacteria (PSB) has emerged as an effective component in esuriently production system. It has potential to reduce the requirement of phosphatic fertilizers. Most of the inorganic phosphorus in the soil is fixed with clay minerals. A large part of the applied water soluble phosphorus is also fixed in soil. So, PSB plays an important role as biofertilizer and have capacity to solublize and mobilize phosphorus and thereby increased its availability to crop. The use of phosphorus solublizing bacteria (*Pseudomonas*, *Bacillus*) as inoculants simultaneously increase phosphorus uptake by the plant and crop yield. Mycorrhiza inhabits roots of several crops and solubilizes soil phosphates. VAM (Vasicular arbuscular mycorrhiza) fungi inoculated to crop plants, colonize the plant root system and increase the growth and yield of crop plants. inoculation of mycorrhiza increase the availability of phosphorus

Materials and Methods

The experiment was conducted in the research farm of Indian Institute of Rice Research (IIRR) Rajendranagar, Hyderabad, (Telangana) during *kharif* season of 2014. It comes under the Southern Telangana agro-climatic zone of Andhra Pradesh. The crop received 552 mm total rainfall. The soil of experimental field was sandy clay loam in texture, alkaline in pH (8.2) and medium in nitrogen (257 kg ha^{-1}) and low in phosphorus (3.8 kg ha^{-1}) and high in potassium (458 kg ha^{-1}).The treatments consisted of two rice cultivars *viz.* IR-64 as and PAC-837 main plots and four nutrient management *viz.* 75 per cent RDF, 75 per cent RDF + Biofertilizers (Azospirillum, PSB, VAM @ 5 kg ha^{-1}) 100 per cent RDF, 100 per cent RDF + Biofertilizers (Azospirillum, PSB, VAM @ 5 kg ha^{-1}) as sub-plots. The experiment was laid out in split plot design replicated thrice. The recommended fertilizer schedule applied was 120:60:60 kg N, P_2O_5, K_2O ha^{-1} through urea, single super phosphate and muriate of potash. The experiment was conducted under assured irrigation facilities and need based irrigations were applied to aerobic rice as per recommended practices. Irrigation was given to crop to maintain soil saturation only instead of flooding. The crop was shown through direct seeding method on 13^{th} June 2014 and harvested on 13 th November, 2014

Results and Discussion

Yield

The results of table 1 showed that there was significant difference between grain yield of rice due to cultivars and its nutrient management under aerobic condition. Cultivars PAC-837 produced the highest grain yield (3.77 t ha^{-1}) which was significantly superior over the IR-64 (2.90 t ha^{-1}). This might be due to its profuse tillering, maximum dry matter accumulation and higher value of yield attributing characters *viz* number of panicles and number of grains $panicles^{-1}$.Among nutrient management revealed that application of 100 per cent RDF + Biofertilizer (N_4) significantly produced higher grain yield as compared to other treatments. The lowest grain yield was obtained under application of 75 per cent RDF (N_1).

Data pertaining to straw yield was not found significant due to different cultivars. Among nutrient management, straw yield increased with increased in dose of fertilizers along with and without biofertilizers. Application of 100 per cent RDF + Biofertilizers (N_4) recorded significantly higher straw yield (4.25 t ha^{-1}). The lowest straw yield was recorded with application of 75 per cent RDF (3.13 t ha^{-1}). More leaf area and dry matter accumulation provide a source for generating more carbohydrates resulted in higher straw yield. These results are in consonance with the findings of Dhar *et al.* (2007), Sathiya and Ramesh (2009) [8] also reported similar findings.

Table 1: Effect of integrated nutrient management on yield, nutrient content and uptake of aerobic rice

Treatments	Grain Yield (t ha^{-1})	Straw yield (t ha^{-1})	N content (%)		P content (%)		K content (%)		N uptake (Kg ha^{-1})			P uptake (Kg ha^{-1})			K uptake (Kg ha^{-1})		
			Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Cultivars																	
V_1- IR-64	2.90	3.48	1.28	0.43	0.29	0.04	0.50	2.11	37.14	8.00	45.40	8.54	0.72	9.26	14.12	61.46	75.58
V_2- PAC-837	3.77	3.91	1.30	0.43	0.30	0.05	0.48	2.02	48.88	13.51	62.39	11.14	1.46	12.60	17.47	76.15	93.62
SEm±	0.09	0.55	0.05	0.01	0.1	0.00	0.04	0.05	0.33	0.54	0.58	0.39	0.03	0.36	0.13	1.61	1.50
CD (P= 0.05)	0.57	NS	NS	NS	NS	NS	NS	NS	1.99	3.08	3.51	2.35	0.17	2.19	0.39	4.83	4.50
Nutrient management																	
N_1- 75% RDF	2.89	3.13	1.31	0.42	0.28	0.04	0.48	2.05	37.91	6.84	44.76	8.48	0.64	9.12	14.29	58.93	73.22
N_2- 75% RDF + Biofertilizers	3.10	3.42	1.28	0.43	0.28	0.04	0.48	2.06	39.59	8.26	47.85	9.44	0.85	10.29	14.98	63.74	78.72
N_3- 100% RDF	3.46	3.98	1.29	0.43	0.30	0.04	0.49	2.03	44.82	10.64	55.46	9.64	1.17	10.81	16.33	72.36	88.69
N_4- 100% RDF + Biofertilizers	3.91	4.25	1.27	0.44	0.31	0.05	0.49	2.11	50.52	17.24	67.80	11.79	1.70	13.29	17.57	80.21	97.78
SEm±	0.05	0.07	0.02	0.02	0.01	0.00	0.02	0.04	0.84	0.51	0.83	0.18	0.05	0.21	0.44	1.36	1.31
CD (P= 0.05)	0.16	0.23	NS	NS	0.02	NS	NS	NS	2.58	1.51	2.53	0.55	0.16	0.64	1.37	4.21	4.02

Nutrient Content and Uptake

Nitrogen and potassium per cent in grain and straw and phosphorus content per cent in straw were not influenced significantly due to different nutrient management. As regards to nutrient management, application of 100 per cent RDF + Biofertilizers (N_4) recorded significantly higher phosphorus content in grain over other doses. However, it was statistically at par with 75 per cent RDF + Biofertilizers (N_2) and 100 per cent RDF (N3). The lowest phosphorus content was recorded under application of 75 per cent RDF (N_1). This was due to the solublization of P in the soil by PSB which is made available to the crop. Panwar *et al.* (2014) [5] also reported similar findings.

Nitrogen, phosphorus and potassium uptake by grain and straw and total uptake were significantly affected due to the cultivars and nutrient management. The maximum nitrogen, phosphorus and potassium uptake in grain, straw were recorded with cultivars PAC-837 as compared to IR -64. Among nutrient management, application of 100 per cent RDF (N_4) obtained significantly higher N, P, K uptake by grain, straw and total uptake as compared to other treatments. The lowest N, P,K uptake by grain and straw and total uptake were observed under the application of 75 per cent RDF (N_1).The positive response of increased dose of nitrogen might be due to the higher uptake of nitrogen from soil which was supplied in sufficient quantity through 100 per cent RDF and biofertilizers like Azospirillum which is a N-fixer and improves the nitrogen content in plant by fixing atmospheric nitrogen and PSB which solublized the fixed P and made available to plant and uptake of NPK which increases availability of nutrients for the plant growth. Similar findings were also observed by Panwar *et al.* (2014) [5], Makarim *et al.* (2005) [3], Netam *et al.* (2008) [4].

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