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Research Article

EFFECT OF ORGANIC AND INORGANIC SOURCES OF NUTRIENTS ON NPK CONTENT IN RICE AT VARIOUS GROWTH PERIODS

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Abstract: A field experiment was conducted as doctoral research for two consecutive years (2011-2012 and 2012-2013) on fine texture soils of Agricultural college farm, Bapatla as a doctoral research to find out the effect of different sources of nutrients on NPK content in rice at various growth periods. The experiment was laidout in a randomized block design in *kharif* season with four treatments and replicated five times. The treatments consisted of M_1 (RDF - Control), M_2 (10t FYM ha^{-1} + RDF), M3 (1.5t vermicompost ha^{-1} + RDF), M_4 (Green manuring + RDF). The NPK content in rice at various growth periods was significantly increased with the application of 100%NPK in combination with FYM @10t ha^{-1}. However, it was on par with that of green manuring together with 100% NPK during both the years of the study.

Keywords: Organic sources, inorganic sources, N content, P content, K content and rice crop

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Introduction

Rice (*Oryza sativa L.*) is the most important food grain crop next only to wheat in world and in India. Among several management practices that affect soil quality, fertilizer application is of paramount importance for its role in growth and development of the crop. In spite of increased cost of fertilizer and their adverse affect on soil environment the best alternative sources for plant nutrients to be explored to meet partial or full requirement of crop. Hence, it is time to pay serious attention to nutrient management. The integrated use of organic manures and inorganic fertilizers can help to maintain optimum crop yields and high nutrient content in crop which helps bioavailability in humans and may contributes to overcome nutrient deficiency.

Materials and Methods

In order to investigate the influence of different sources of nutrients on NPK content in rice, the present experiment was conducted in the field number 49A and 49B of the Agricultural College Farm, Bapatla, during the years 2011-12 and 2012-13, respectively. Prior to preparatory cultivation of the experimental site, soil samples from 0 to 15 cm depth were collected at random and a composite soil sample during both the years was analyzed for different physico-chemical properties. The results of the soil analytical data indicated that the experimental soil is clay and sandy clay during first and second year, respectively in texture, slightly alkaline in reaction, low in organic carbon (0.52 and 0.50% during first and second year, respectively) and available nitrogen (175.6 and 159.8kg ha^{-1} during first and second year, respectively), and high in available phosphorus (95.3 and 93.9 kg P_2O_5 ha^{-1} during first and second year, respectively) and potassium (960.0 and 925.6 kg K_2O ha^{-1} during first and second year, respectively).

The experiment consisted of four treatments *viz*., M_1 (RDF - Control), M_2 (10t FYM ha^{-1} + RDF), M_3 (1.5t vermicompost ha^{-1} + RDF), M_4 (Green manuring + RDF). The experiment is laid out in RBD and replicated five times. The recommended fertilizer dose was applied as 160:40:40kg N, P_2O_5 and K_2O ha^{-1}. A popular super fine rice cultivar BPT 5204 (Samba Mashuri) was selected for kharif season. It is a cross between (GEB-24 x TN-1) and Mashuri. FYM and vermicompost were added 7 days before transplanting of rice on dry weight basis. Dhaincha crop was raised with the seed rate of 60kg ha-1 in individual plots and it was incorporated 7 days before transplanting of rice as green manure at flowering stage. Nitrogen was applied in the form of urea in three splits, first split at the time of transplanting, second split at 30 DAT and third split at 60 DAT. Phosphorus was applied in the form of SSP as basal dose before transplanting. Potassium was applied in the farm of MoP in two splits, first split as basal before transplanting and second split at 60 DAT. Available nitrogen was estimated by alkaline permanganate method by using macro Kjeldahl distillation unit [9]. Available phosphorus was extracted with Olsen's [5] and estimated using spectrophotometer as described by Watanabe and Olsen (1965) [10]. Available potassium was extracted with neutral normal ammonium acetate and estimated with the help of flame photometer [4]. Plant samples of rice were collected from destructive rows at various growth periods and five randomly selected plants at harvest stage. The samples were first dried in shade and then in hot air oven at 65oC. The plant samples were ground in willey mill and stored in labeled brown paper bags for analysis. The grain samples were also processed and stored in similar fashion.N content in plant samples was determined by micro Kjeldahl method [6]. Di-acid extract was prepared as per the method outlined by Jackson (1973) [3]. It was carried out using a 9:4 mixture of HNO_3:$HClO_4$.

Table-1 Influence of organics on nitrogen content (%) at different growth periods of rice

Treatment	2011-2012					2012-2013				
	30 DAT	60 DAT	90 DAT	Straw	Grain	30 DAT	60 DAT	90 DAT	Straw	Grain
M_1- RDF (Control)	1.59	1.54	1.35	0.88	1.22	1.41	1.28	1.07	0.94	1.18
M_2- FYM 10t ha^{-1} + RDF	1.75	1.67	1.56	1.01	1.49	1.65	1.49	1.30	1.11	1.49
M_3- Vermicompost 1.5t ha^{-1} + RDF	1.74	1.64	1.54	0.99	1.48	1.62	1.41	1.27	1.08	1.39
M_4 - Green manuring + RDF	1.75	1.65	1.55	1.00	1.47	1.63	1.43	1.28	1.09	1.42
SEm ±	0.050	0.037	0.047	0.022	0.057	0.044	0.040	0.038	0.035	0.029
CD (P: 0.05)	0.15	0.11	0.15	0.07	0.17	0.13	0.12	0.12	0.11	0.09
CV (%)	7.0	5.1	7.1	5.1	9.0	6.2	6.4	6.9	7.3	4.7

Table-2 Influence of organics on phosphorus content (%) at different growth periods of rice

Treatment	2011-2012					2012-2013				
	30 DAT	60 DAT	90 DAT	Straw	Grain	30 DAT	60 DAT	90 DAT	Straw	Grain
M_1- RDF (Control)	0.270	0.220	0.178	0.137	0.393	0.243	0.219	0.173	0.138	0.335
M_2- FYM 10t ha^{-1} + RDF	0.326	0.243	0.224	0.172	0.476	0.315	0.267	0.221	0.169	0.393
M_3- Vermicompost 1.5t ha^{-1} + RDF	0.316	0.240	0.218	0.167	0.434	0.275	0.256	0.203	0.166	0.377
M_4 - Green manuring + RDF	0.333	0.241	0.219	0.168	0.450	0.283	0.260	0.219	0.164	0.385
SEm ±	0.010	0.005	0.006	0.003	0.012	0.008	0.008	0.006	0.005	0.011
CD (P: 0.05)	0.032	0.016	0.018	0.009	0.038	0.024	0.024	0.017	0.015	0.032
CV (%)	7.4	4.8	6.1	4.1	6.3	6.3	7.0	5.4	6.9	6.3

Table-3 Influence of organics on potassium content (%) at different growth periods of rice

Treatment	2011-2012					2012-2013				
	30 DAT	60 DAT	90 DAT	Straw	Grain	30 DAT	60 DAT	90 DAT	Straw	Grain
M_1- RDF (Control)	2.38	2.28	1.83	1.65	0.42	2.50	2.07	1.70	1.66	0.281
M_2- FYM 10t ha^{-1} + RDF	2.72	2.60	2.20	1.88	0.52	2.89	2.70	1.95	1.85	0.319
M_3- Vermicompost 1.5t ha^{-1} + RDF	2.71	2.50	2.07	1.79	0.51	2.83	2.38	1.93	1.84	0.308
M_4 - Green manuring + RDF	2.70	2.54	2.18	1.85	0.50	2.85	2.42	2.10	1.86	0.310
SEm ±	0.066	0.069	0.070	0.044	0.018	0.087	0.061	0.057	0.052	0.008
CD (P: 0.05)	0.20	0.21	0.21	0.14	0.06	0.27	0.19	0.18	0.16	0.02
CV(%)	5.6	6.2	7.5	5.5	8.4	7.0	5.7	6.6	6.4	5.8

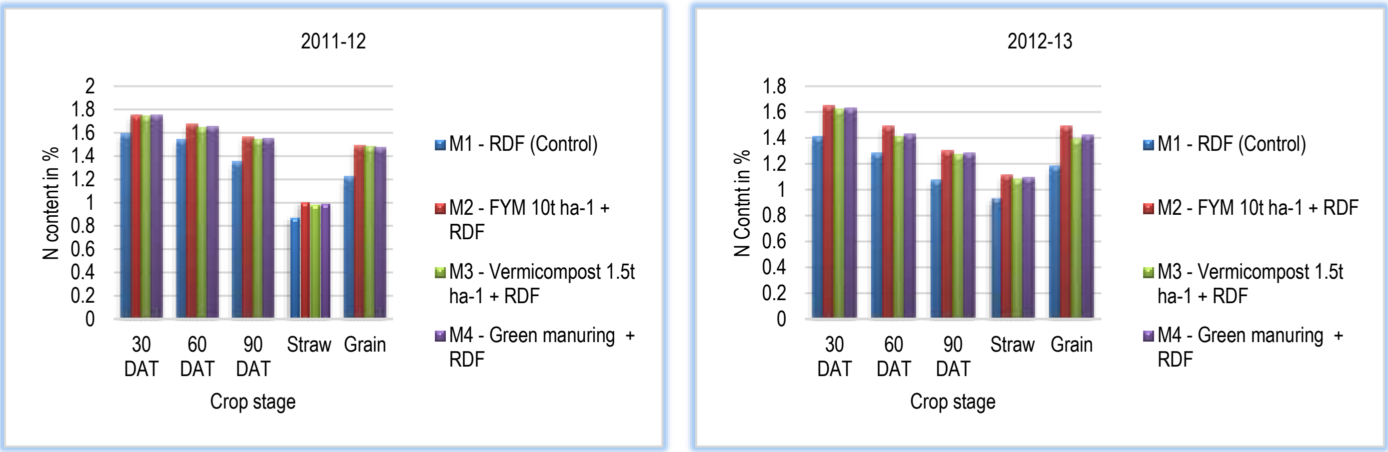

Fig-1 Influence of organics on nitrogen content (%) at different growth periods of rice

The predigestion of sample was done by using 10ml of HNO_3 g^{-1} sample. This di-acid extract was used to determine P and K content in the plant and grain samples. Phosphorus was determined spectrophotometrically by vanadomolybdate phosphoric acid yellow color method as described by Jackson (1973) [3] from di-acid extract. Potassium was estimated from di-acid extract by using flame photometer [3].

Results and Discussion

Nitrogen content in rice

N content in rice at 30 DAT, 60 DAT, 90 DAT and maturity was presented in the table 1. Perusal of the data revealed that the treatment M_2 recorded maximum N content in straw (1.75%, 1.67%, 1.56% and 1.01% at 30, 60, 90 DAT and maturity, respectively) during 2011 *kharif* at all the stages of growth over other treatments. Similar trend was observed in 2012 also. Irrespective of growth stage of rice and year of the study, that the treatments, received organics along with RDF significantly increased the N content over the treatment received RDF alone except at 30 DAT and 60 DAT in 2011 *kharif* season where the treatment M_3 was on par with M_1. The respective improvement in N content in organic treatments along with inorganic sources might be due to the reason that nutrients were released slowly from organics, which amended the nutrients to the soil along with inorganic sources made it available throughout the growing season [1]. Irrespective of the year of the study the N content in rice straw was found decreased with the growth stage from 30 DAT to maturity. The maximum N content was recorded at 30 DAT in all treatments. When compared to straw at maturity (0.88 to 1.01%) the N content in grain (1.22 to 1.49%) was recorded higher in all treatments. The N content in grain ranging from 1.26 to 1.39% and in straw 0.65 to 0.83% was mentioned earlier by Rahaman *et al.* (2007) [6]. Irrespective of the year of the study among the organic sources, M_2 recorded maximum N content in grain (1.49% in 2011 and 2012) over others. The treatments those received organics along with inorganic sources of nutrients showed significant superiority over RDF alone. During second year of the study, N content in grain recorded in the treatment M_2 (1.49%) was significantly higher than that of M_3 (1.39%). It might be due to higher addition of nitrogen to the soil though FYM.

Kadu *et al*. (1991) reported that N content in rice increased significantly with NPK + FYM application. The increased N content in rice grain and straw with the application of NK + P + FYM over NK application was also recorded earlier by Ranjha *et al*. (2001) [7].

Phosphorous content in rice

P content at 30 DAT, 60 DAT, 90 DAT and maturity was significantly influenced by different treatments imposed of nutrients during both the years of study (Table 2). Irrespective of growth stage of rice and year of the study, the treatments those received organics along with the RDF (M_2, M_3 and M_4) significantly increased the P content over the treatment that received RDF alone (M_1). The highest P content with 0.315, 0.267, 0.221 and 0.169 per cent in straw at 30, 60, 90 DAT and maturity, respectively was observed in the treatment received FYM @ 10t ha^{-1} + RDF (M_2) during second year of the study. Similar trend was noticed during first year of the study except at 30 DAT in which the highest P content (0.333%) was recorded in the treatment M4. These results were in conformity with the findings of Ranjha *et al*. (2001) [7], who found that the increased P content in grain and straw by the application of NPK + FYM over NK application. Irrespective of the year of the study, the P content in rice straw was found decreased with the growth stage from 30 DAT to maturity. The maximum P content was recorded at 30 DAT in all treatments. When compared to rice straw at all growth stages (30, 60, 90 DAT and maturity) of rice the P content in grain (0.335, 0.393, 0.377 and 0.385 per cent in treatments M_1, M_2, M_3 and M_4 respectively during second year) was recorded high in all treatments. These results were in line with the findings of Islam *et al*. (2010) [2], who found higher P content (0.293-0.327%) in grain than that of straw (0.158-0.198) in all cases. The best treatment (M2) recorded 21.1 and 17.3% higher P content in grain over the treatment M1. Kadu *et al*. (1991) [4] reported that grain P was highest with NPK + FYM application.

Potassium content in rice

Results presented in table 3 revealed that K content at 30 DAT, 60 DAT, 90 DAT and maturity was significantly influenced by different sources of nutrients during both the years of study. The highest K content in rice strawat all growth stages was observed in the treatment that received FYM @ 10t ha^{-1} + RDF (M_2) (2.72, 2.60, 2.20, and 1.88%, at 30, 60, 90 DAT and maturity respectively during 2011). Similar trend was observed in 2012 except 90 DAT in 2012 *kharif* in which the highest (2.10%) K content was recorded in the treatment M_4. These results agreed with those of Ranjha *et al.* (2001) [7] who, reported that potassium concentration of rice grain and straw increased from 0.17 to 0.25 and 1.26 to 1.61, respectively, over control and maximum content were noted in treatments where FYM was applied. Irrespective of the year of the study, the K content in rice straw was found decreased with the growth stage from 30 DAT to maturity. It might be due to dilution effect of nutrients. The maximum K content was recorded at 30 DAT in all treatments. In contrary to P content, the K content in grain was recorded low in all treatments when compared to rice straw at all growth stages of rice. These results were in close conformity with the findings of Islam *et al*. (2010) [1] who reported that the K content in rice straw was recorded higher than that of rice grain in all treatments. The highest K content in rice grain was recorded in the treatment M_2 (0.52 and 0.32%) which was 23.8 and 14.3% higher than that of M1 treatment during 2011 and 2012, respectively.

Application of research: This research can be useful in different nutrients content at different stages of crop growth and it also helps which nutrient management can fortify the nutrient rich food for human health point of view.

Research Category: Soil fertility and crop productivity

Abbreviations:
DAT: Days after transplanting
FYM: Farm yard manure
NPK: Nitrogen, Phosphorous, Potassium
RDF: Recommended dose of fertilizers

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Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Sample Collection: Plant samples of rice were collected from five randomly selected plants at harvest stage. The samples were first dried in shade and then in hot air oven at 65ºC. The plant samples were ground in willey mill and stored in labeled brown paper bags for analysis. The grain samples were also processed and stored in similar fashion.

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