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RESIDUAL EFFECT OF DIFFERENT SOURCES OF NUTRIENTS ON K CONTENT IN MAIZE AT DIFFERENT GROWTH STAGES IN RICE FALLOW MAIZE CROPPING SYSTEM

Dr. Mohana Rao Puli*[1], P. R. K. Prasad[2], P. Ravindra Babu[3], Dr K. L. Narasimha Rao[4], B. Srihari Rao[5]

[1]Scientist, Soil Science, Saline Water Scheme, Bapatla.

[2]Professor and Head, SSAC, Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla.

[3]Professor, SSAC, Department of Soil Science and Agricultural Chemistry, Agricultural College, Bapatla.

[4]Professor and Head, Dept of Crop Physiology.

[5]SMS, Soil Science, BCT KVK, Haripuram.

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***Corresponding Author**
Dr. Mohana Rao Puli
Scientist, Soil Science,
Saline Water Scheme,
Bapatla.

ABSTRACT

A field experiment was conducted for two consecutive years (2011-2012 and 2012-2013) during Ph. D. work on fine texture soils of agricultural college farm, Bapatla to find out the residual effect of different sources of nutrients applied to preceding rice on P content in maize at different growth stages. The experiment was laidout in a randomized block design in *kharif* season with four treatments. The treatments consisted of M_1 (RDF - Control), M_2 (10t FYM ha^{-1} + RDF), M_3 (1.5t vermicompost ha^{-1} + RDF), M_4 (Green manuring + RDF). During the immediate *rabi*, the experiment was laid out in a split-plot design without disturbing the soil for succeeding maize with the four treatments given to *kharif* rice as main plot treatments and each of these divided into five sub-plots to receive five levels of fertilizer NPK application *viz.*, N_1 - 75%NPK, N_2 - 100% NPK, N_3 – 125% NPK, N_4 - 150% NPK and N_5 - 175% NPK for succeeding maize. Data collected on K content in maize at different growth stages was significantly increased with the application of 100%NPK in combination with FYM @10t ha^{-1} to preceding rice crop, irrespective of the NPK levels applied to succeeding maize crop. However, it was on par with that of green manuring together with 100% NPK during both the years of the study.

KEYWORDS: FYM, green manuring, vermicompost, N content**.**

MATERIALS AND METHODS

Doctoral research 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 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 was laid out in RBD. The recommended fertilizer dose was applied as 160:40:40 kg N, P_2O_5 and K_2O ha^{-1}. During the immediate *rabi*, the experiment was laid out in a split-plot design without disturbing the soil for succeeding maize with the four treatments given to *kharif* rice as main plot treatments and each of these divided into five sub-plots to receive five levels of fertilizer NPK application *viz*., N_1 - 75%NPK, N_2 - 100% NPK, N_3 - 125% NPK, N_4 - 150% NPK and N_5 - 175% NPK for succeeding maize. The experiment on rice - maize sequence as detailed above was repeated on a separate site but in the same block during *kharif* 2012 and *rabi* 2013, respectively. Popular cultivars of rice and maize, BPT – 5204 and 30 V 92, respectively, were used for the study.

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 DAP and remaining N was applied in the form of urea, in three equal splits, first split at 10 DAS, second split at knee high stage and third split at tasseling stage. Half dose of K and full dose of P was applied, in the form of MoP and DAP respectively, at 10 days after sowing. Remaining half dose of K was applied at tasseling stage. All fertilizers were applied in pocketing method as per the treatments.

Plant samples of maize were collected from five randomly selected plants at different growth stages. The samples were first dried in shade and then in hot air oven at 65^{o}C. 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. Di-acid extract was prepared as per the method outlined by Jackson (1973). It was carried out using a 9:4 mixture of HNO_3: $HClO_4$. The predigestion of sample was done by using 10ml of HNO_3 g^{-1} sample. This di-acid extract was used to determine K content in the plant and grain samples by using flame photometer (Jackson, 1973).

RESULTS AND DISCUSSION

K content in maize at knee high stage

Critical observation of the data presented in the table 1 revealed that the K content in maize at knee high stage increased with increase in level of NPK application to maize regardless the organics applied to preceding rice crop during both the years of the study. The highest mean K content was recorded in the treatment N_5 (175% NPK) with 3.36 and 3.40% followed by N_4 (150% NPK) with 3.25 and 3.33% in 2012 and 2013 respectively. These results were in agreement with the findings of Grunes and Krantz (1958) who found that the N fertilization led to increased concentration of K in plant tissue.

Organics application in combination with inorganic fertilizers to preceding rice crop, irrespective of NPK levels influenced in significant increase in K content of succeeding maize in *rabi* than the treatment that had not received organics during both the years of study. The highest mean K content was recorded in the treatment M_2 (10t FYM ha^{-1} + 100% NPK to rice) with 3.14 and 3.30% in 2012 and 2013 respectively. Overall, the highest K content was recorded in the treatment M_2N_5 (10t FYM ha^{-1} + 100% NPK to rice and 175 % NPK to maize) with 3.50 and 3.51% in 2012 and 2013 respectively.

K content in maize at tasseling stage

At tasseling stage, similar trend was observed in both the years of study. But the residual effect of vermicompost (M_3) on K content of maize during first year was non-significant to the RDF treatment (M_1) to preceding rice crop. However, K content showed significant increase with increase in level of NPK and the highest mean K content was recorded at 175% NPK with 2.75 and 2.90% followed by 150% NPK with 2.71 and 2.82% during first and second year of the study, respectively which were on par with each other (Table 2).

K content in maize kernel

K content in maize kernel significantly increased with increase in level of NPK application to maize up to 125% NPK regardless the organics applied to preceding rice crop during both the years of the study (Table 3). The highest mean K content in kernel was recorded in the treatment N_5 (175% NPK) with 0.380 and 0.400% followed by N_4 (150% NPK) with 0.373 and 0.392% in 2012 and 2013, respectively. As the NPK levels increased from 125% to 175%, the K content in maize kernel was on par with each other irrespective of the organics applied to preceding rice crop during second year of the study. These results were in conformity with the findings of Hussaini *et al*. (2008) who reported the increased concentration of K in maize kernel with increased level of N and P fertilizers and the concentration ranged from 0.33 to 0.34%.

FYM application @ 10t ha^{-1} in combination with inorganic fertilizers (M_2) to preceding rice crop, irrespective of NPK levels resulted in significant increase in K content of succeeding maize kernel in *rabi* than the treatment that had not received organics, during both the years of study. The highest mean K content in maize kernel was recorded in the treatment M_2 (10t FYM ha^{-1} + 100% NPK to rice) with 0.364 and 0.384% in 2012 and 2013, respectively. The interaction effect noticed was significant overall. The highest K content was recorded in the treatment M_2N_5 (10t FYM ha^{-1} + 100% NPK to rice and 175 % NPK to maize) with 0.390 and 0.411% in 2012 and 2013, respectively.

K content in maize stover

K content in maize stover significantly increased with increase in level of NPK application to maize up to 125% NPK and the treatments N_3, N_4 and N_5 were on par with each other regardless the organics applied to preceding rice crop during second year of study. During first year this significance appeared with each 50% increment of NPK level (Table 4). The highest mean K content in maize stover was recorded in the treatment N_5 (175% NPK) with 2.24 and 2.30% followed by N_4 (150% NPK) with 2.18 and 2.25% in 2012 and 2013, respectively which were on par with each other.

FYM application @ 10t ha^{-1} or green manuring in combination with inorganic fertilizers to preceding rice crop, irrespective of NPK levels, resulted in significant increase in K content of succeeding maize stover in *rabi* than the treatment that had not received organics during first year of study. Whereas, during the second year of study, organics application (M_2, M_3 and M_4) to preceding rice crop, irrespective of level of inorganics resulted in significant

increase in K content over inorganic alone (M_1). The highest mean K content in maize stover was recorded in the treatment M_2 with 2.17 and 2.25% followed by M_4 with 2.11 and 2.21% in 2012 and 2013, respectively. The interaction effect was significant overall. The highest K content was recorded in the treatment M_2N_5 (10t FYM ha^{-1} + 100% NPK to rice and 175 % NPK to maize) and M_4N_5 (green manuring + 100% NPK to rice and 175 % NPK to maize) with 2.28% in 2012 (Table 4).

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Table 1: Influence of organics applied to preceding rice crop and NPK levels on K content (%) in maize at knee high stage.

NPK levels	2011-2012				Mean	2012-2013				Mean
	Organics applied to preceding rice crop					Organics applied to preceding rice crop				
	M1	M2	M3	M4		M1	M2	M3	M4	
N1-75% RDF	2.43	2.79	2.70	2.82	2.69	2.58	2.99	2.92	2.87	2.84
N2-100% RDF	2.73	2.92	2.91	2.94	2.87	2.87	3.26	3.16	2.93	3.05
N3-125% RDF	2.88	3.12	3.08	3.15	3.06	2.97	3.34	3.31	3.32	3.24
N4-150% RDF	3.08	3.38	3.28	3.25	3.25	3.13	3.42	3.38	3.40	3.33
N5-175% RDF	3.28	3.50	3.30	3.38	3.36	3.23	3.51	3.37	3.49	3.40
Mean	2.88	3.14	3.05	3.11	3.04	2.96	3.30	3.23	3.20	3.17
	SEm ±	CD (p=0.05)	CV (%)			SEm ±	CD (p=0.05)	CV (%)		
M	0.047	0.16	6.0			0.054	0.19	6.6		
N	0.039	0.11	4.4			0.053	0.15	5.8		
M x N Interaction										
N at same M	0.077	0.22				0.106	0.30			
M at same or diff. N level	0.084	0.17				0.109	0.23			

M_1- RDF (Control), M_2- FYM 10t ha^{-1} + RDF, M_3 - Vermicompost 1.5t ha^{-1} + RDF, M_4- Green manuring + RDF

M - Organics applied to preceding rice crop

N - Nutrient levels applied to maize crop

Table 2: Influence of organics applied to preceding rice crop and NPK levels on K content (%) in maize at tasseling stage.

NPK levels	2011-2012				Mean	2012-2013				Mean
	Organics applied to preceding rice crop					Organics applied to preceding rice crop				
	M1	M2	M3	M4		M1	M2	M3	M4	
N1-75% RDF	2.15	2.29	2.27	2.28	2.25	2.16	2.39	2.34	2.34	2.31
N2-100% RDF	2.32	2.56	2.37	2.56	2.45	2.32	2.65	2.60	2.62	2.54
N3-125% RDF	2.41	2.84	2.60	2.70	2.64	2.57	2.90	2.70	2.82	2.75
N4-150% RDF	2.60	2.85	2.63	2.76	2.71	2.62	2.95	2.82	2.88	2.82
N5-175% RDF	2.63	2.91	2.66	2.80	2.75	2.65	3.03	2.95	2.98	2.90
Mean	2.42	2.69	2.51	2.62	2.56	2.46	2.78	2.68	2.73	2.66
	SEm ±	CD (p=0.05)	CV (%)			SEm ±	CD (p=0.05)	CV (%)		
M	0.035	0.12	5.2			0.040	0.14	5.8		
N	0.043	0.13	5.9			0.039	0.11	5.1		
M x N Interaction										
N at same M	0.087	0.25				0.079	0.23			
M at same or diff. N level	0.085	0.17				0.081	0.17			

M_1- RDF (Control), M_2- FYM 10t ha^{-1} + RDF, M_3 - Vermicompost 1.5t ha^{-1} + RDF, M_4- Green manuring + RDF

M - Organics applied to preceding rice crop

N - Nutrient levels applied to maize crop

Table 3: Influence of organics applied to preceding rice crop and NPK levels on K content (%) in maize kernel.

NPK levels	2011-2012				Mean	2012-2013				Mean
	Organics applied to preceding rice crop					Organics applied to preceding rice crop				
	M1	M2	M3	M4		M1	M2	M3	M4	
N1-75% RDF	0.289	0.319	0.335	0.319	0.316	0.299	0.335	0.322	0.335	0.323
N2-100% RDF	0.324	0.350	0.342	0.335	0.338	0.324	0.370	0.347	0.357	0.350
N3-125% RDF	0.352	0.378	0.352	0.360	0.361	0.362	0.401	0.375	0.385	0.381
N4-150% RDF	0.368	0.383	0.368	0.375	0.373	0.380	0.406	0.388	0.395	0.392
N5-175% RDF	0.375	0.390	0.375	0.380	0.380	0.388	0.411	0.395	0.406	0.400
Mean	0.342	0.364	0.354	0.354	0.353	0.351	0.384	0.366	0.376	0.369
	SEm ±	CD (p=0.05)	CV (%)			SEm ±	CD (p=0.05)	CV (%)		
M	0.006	0.020	6.3			0.005	0.018	5.3		
N	0.005	0.015	5.1			0.006	0.016	5.3		
M x N Interaction										
N at same M	0.010	0.030				0.011	0.032			
M at same or diff. N level	0.011	0.023				0.011	0.023			

M_1- RDF (Control), M_2- FYM 10t ha^{-1} + RDF, M_3 - Vermicompost 1.5t ha^{-1} + RDF, M_4- Green manuring + RDF

M - Organics applied to preceding rice crop

N - Nutrient levels applied to maize crop

Table 4: Influence of organics applied to preceding rice crop and NPK levels on K content (%) in maize stover.

NPK levels	2011-2012				Mean	2012-2013				Mean
	Organics applied to preceding rice crop					Organics applied to preceding rice crop				
	M1	M2	M3	M4		M1	M2	M3	M4	
N1-75% RDF	1.80	1.98	1.88	1.93	1.89	1.81	2.01	1.97	1.99	1.94
N2-100% RDF	1.93	2.10	2.00	2.03	2.02	1.87	2.18	2.01	2.17	2.06
N3-125% RDF	2.03	2.23	2.13	2.10	2.12	2.02	2.35	2.25	2.27	2.22
N4-150% RDF	2.10	2.26	2.15	2.21	2.18	2.11	2.35	2.26	2.28	2.25
N5-175% RDF	2.15	2.28	2.23	2.28	2.24	2.18	2.38	2.30	2.32	2.30
Mean	2.00	2.17	2.08	2.11	2.09	2.00	2.25	2.16	2.21	2.15
	SEm ±	CD (p=0.05)	CV (%)			SEm ±	CD (p=0.05)	CV (%)		
M	0.029	0.10	5.4			0.034	0.12	6.0		
N	0.038	0.11	6.2			0.030	0.09	4.8		
M x N Interaction										
N at same M	0.075	0.22				0.060	0.17			
M at same or diff. N level	0.073	0.15				0.063	0.13			

M_1- RDF (Control), M_2- FYM 10t ha^{-1} + RDF, M_3 - Vermicompost 1.5t ha^{-1} + RDF, M_4- Green manuring + RDF

M - Organics applied to preceding rice crop

N - Nutrient levels applied to maize crop