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RESEARCH ARTICLE

Influence of long term use of fertilizers and manures on available nutrient status and inorganic "Phosphorous" fractions in soil under continuous rice – rice cropping system.

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Abstract

Available status and inorganic 'P' fractions were studied in the ten year old Long Term Fertilizer Experiment on rice – rice cropping system at Regional Agricultural Research Station, Acharya N.G.Ranga Agricultural University, Jagtial, A.P, India. Available phosphorous content build up was observed where it was applied and its depletion where it was observed where it was not applied. The available phosphorous depletion was more under imbalanced fertilization (- 3.5 % from the initial status) than under control (4.9% decrease). Available phosphorous build up was highest with application of higher rate of fertilizer than optimum level (123% increase) and application of FYM along with optimum fertilizer (140% increase) . All the inorganic 'P' fractions increased over the initial levels where ever P fertilizer were applied and decreased where it was not applied.
Available nitrogen content increased and available potassium content decreased in all the treatments with or without application of the respective nutrient.

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INTRODUCTION

Continuous cultivation of rice after rice every year with fertilizer application resulted in build up of phosphorous in most of the soils of rice growing areas of Andhra Pradesh. Rice yield increase and economic benefit to farmers depends on soil fertility. Soil fertility depends on the status of soil nutrients such as total amount of N,P, K and other nutrients and their capacity to produce these nutrients in the form for easily available to the crop (available nutrients) , toxic substances, soil erosion, being washed out and other ways of lost. It is opined that continuous use of chemical fertilizers under intensive cropping decreases crop yields due to deteoration of soil health and extra removal of nutrients by crops takes place with heavy fertilization.

Mineral fertilizer input is the dominant factor of the overall nutrient balance, but their use is often imbalanced and their use efficiency remains below optimum levels. Managing the variability in soil nutrient supply resulting from intensive rice – rice cultivation is one of the major challenges to sustaining and increasing rice yields.

Phosphorous is one of the major nutrients, which limits plant growth and yields, and its availability is highly correlated with organic and inorganic fractions of soil phosphorous. Changes in P fractions might be due to application of organic manures, inorganic fertilizers, cropping sequences, crop management and environmental conditions. Nutrient imbalance in soil with chemical fertilization is also a cause of excess removal of other nutrients from the soil (Bharadwaj *et al.* 1994).

The objective of present study is to study the influence of continuous use of fertilizers and manures on available phosphorous and inorganic P – fractions in soil with intensive cropping system.

Materials and Methods:

Since ten years, long – term fertilizer experiment (2000-01 onwards) is being conducted with rice – rice cropping system in I block at Regional Agricultural Research Station, Polasa, Jagtial, Acharya N.G. Ranga Agricultural University, A.P. Experimental site soil is a Typic Ustochrept, Clayey in texture. The soil was slightly alkaline in reaction (pH 8.22) and non-saline (EC 0.47 dsm^{-1}). It was low in available nitrogen (107.6 kg ha^{-1}), medium in available phosphorous (19.6 kg ha^{-1}) and high in available potassium (364 kg ha^{-1}) at the initiation. This experiment is continuing with rice- rice cropping system in a fixed lay out and fixed treatments.

The experiment was laid out in a randomised block design with four replications and 11+1 treatments, details are as follows:

T_1 – 50%NPK , T_2 – 100%NPK, T_3 – 150%NPK, T_4 – 100%NPK +HW, T_5 – 100%NPK+$ZnSO_4$ @ 10 kg ha^{-1}(in *kharif*), T_6 – 100%NP, T_7 – 100%N alone, T_8 – 100%NPK+FYM@ 5 t ha^{-1}(in each *kharif*), T_9 – 100%NPK-S, T_{10} – FYM @ 10 t ha^{-1}(in each *kharif* and *rabi*), T_{11} – Control (No fertilizers, No manures), T_{12} – Fallow (No crop , No fertilizers).

The recommended dose of fertilizer 120-60-40 kg N-P_2O_5-K_2O ha^{-1} were applied as per treatments through urea, single super phosphate, muriate of potash respectively. In *rabi* season 2010 and 2011 one month old seedlings (2 $hill^{-1}$) of rice – rice variety Karimnagar Samba (JGL-3855) were transplanted after puddling the field in first week of January with 15cm x 15cm spacing. One third of recommended dose of nitrogen, full dose of phosphorous, half dose of potassium were applied in soil as basal dose at the time of planting. Remaining half N was applied in two equal splits, at tillering and flowering. $ZnSO_4$ was applied @10 kg ha-1 as per treatment in every *kharif* season only. FYM being applied@ 10 t ha^{-1} every season every year, where as in 100%NPK+FYM treatment FYM is being applied @ 10 t ha^{-1} in every *kharif* only.

Soil samples were collected from 0-15 cm from each plot treatment wise during initial before starting of the experiment and in 2010 and 2011 after harvest of rice. These samples were processed analysed for pH, EC, OC, available N.P and K, and inorganic P-fractions using standard procedures.

Results and Discussions:

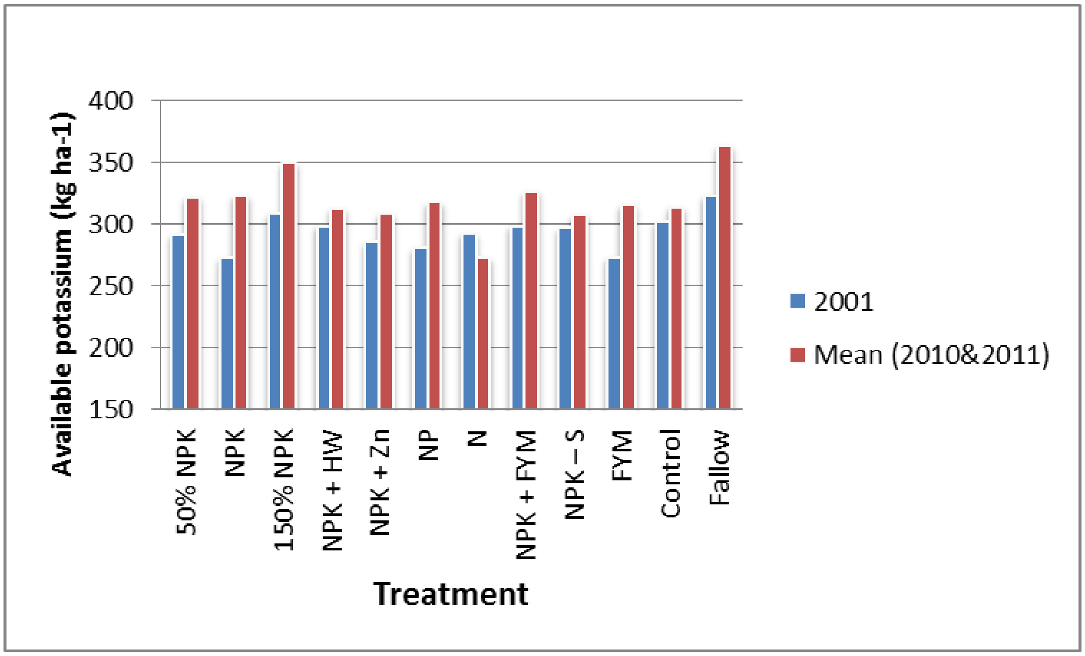
Effect on available nutrients:

In general, continuous cropping with and without fertilizers and organic manures application led to reduction in organic carbon content to 0.50% from the initial value 0.79% , whereas continuous cropping and fertilization had beneficial impact on organic carbon and available N, P and K in soil (Table.1). After 10 years, organic carbon considerably increased from 0.79 to as high as 1.07 % and available nitrogen also increased in all the treatments ranging from 183 to 229 kg ha^{-1} from the initial value 107.6 kg ha^{-1}. Probably due to continuous incorporation of root matter and stubbles of tillers into soil.

Build up of available phosphorous was observed in treatments where it was applied and slight depletion in those where it was not applied. Depletion of “P” was more under application of only 100%N (-3.5% depletion from initial value of 19.6 kg ha^{-1}) than under control treatment (4.9% depletion). This indicates the negative impact of imbalanced fertilizer use. Highest “P” build up was observed in 150%NPK (116%) and 100%NPK+FYM (112%). It is interesting to note that, even though available ‘P’ content under application of nitrogen alone treatment is decreased but the soil is still in medium category (Tabl.1). Subehia *et al.* (2005) and Krishna *et al*. (2007) also reported an increase in available ‘P’ with increase in levels of NPK. The lowest values of available ‘P’ in control and 100%N were due to continuous cropping without any addition of ‘P’ in these treatments (Sharma *et al.*2002).

After ten years of continuous cropping, the status of available potassium (fig.1) decreased in all the treatments ranging from 273 to 364 kg ha^{-1} from the initial value of 364 kg ha^{-1}, but these amounts were not significantly differing among the treatments. Among the fertilizer treatments, the higher levels of available K in 150%NPK are due to higher application rates of K in this treatment. Depletion of available K, even in treatments receiving K fertilization under continuous cropping was also reported by Subehia *et al*. 2005.

Fig. Effect of continuous cropping on available potassium (kg ha^{-1}) in soil.



Effect on inorganic 'P' fractions:

The different forms of inorganic phosphorous fractions viz., Saloid-P, Al – P, Fe –P and Ca – P as influenced by various treatments after 10 years of rice – rice cropping system are presented in Table 2.

The amounts of Saloid –P ranged from 3.7 to 7.0 mg kg $^{-1}$. Among all the treatments highest concentration of Saloid –P was observed in 100%NPK+FYM followed by 150%NPK. Al–P ranged from 39.6 to 104.0 (mean of two years). Same as Saloid-P fractions Al-P fractions also found high in 100%NPK+FYM treatment but these are statistically at par with the values recorded in natural fallow (T12), which in turn showed higher values than 150%NPK treatment. The values of Al-P contents in 150%NPK treatment are statistically at par with the values of 100%NPK, 100%NPK+HW and 100%NPK-S treated plots. Continuous addition of P fertilizers in combination with nitrogen and potassium raised the soil – P content in all the fractions, this increase being more at higher rates of P addition due to the build up of phosphate in soil which got transformed into different inorganic – P fractions. Similar results were also reported by Singh *et al.* 2010.

Fe – P and Ca – P:

The amounts 'P' fractions under Fe – P ranged from 28.2 to 44.2 mg kg^{-1}(mean of two years) and Ca – P are 199.9 to 447.6 mg kg $^{-1}$ (mean of two years). Significantly Fe – P and Ca – P fractions were obtained by 100%NPK+FYM treatment. Remarkably higher values of Ca – P were found as compared to Saloid – P, Fe – P and Al – P in both the years.

In general the contents of various forms of 'P' (Ca –P, Fe – P and Saloid –P) were higher in P – treated plots than those of 'P' untreated plots. Irrespective of the fertilizer or manure application the higher concentration of Fe-P than Saloid –P but lower than Ca –P and Al –P were observed in all the treatments. These results are in conformity by Sihag *et al.* 2005.

It can be concluded on the comparison of various 'P' fractions from the initial and in soils under control treatments that all the inorganic 'P' fractions increased in 10 years. Similar results also reported by Krishna *et al.* 2007.

Application of an optimal (100%) and super optimal (150%) recommended dose of phosphatic fertilizers along with nitrogen, potassium and organic manure resulted in almost at par values of Al –P, Fe –P and Ca – P, but these values were significantly higher as compared to Saloid –P, Al –P, Fe – P and Ca – P under control treatment soils. This could be attributed to relatively higher activities of Ca2+ than Fe 2+ and Al3+ ions in slightly alkaline soils. Similar results were also observed by Stalin et al. (2006) and Abolfazli et al. (2012)

Highest available P was recorded in 150%NPK (42.5 kg ha^{-1}) and 100%NPK + FYM (41.7 kg ha^{-1}); lowest values are recorded in 100%N (19.2 kg ha^{-1}) and control (20.2 kg ha^{-1}). These results are in conformity with those Swarup (2002).

Table.1. Effect of continuous cropping on soil available nutrient status.

Treatments	*Organic carbon* (%)			*Available Nitrogen (kg ha^{-1})*			*Available Phosphorous (kg ha^{-1})*			*Available Potassium (kg ha^{-1})*		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
50% NPK	0.810	0.780	0.790	204	200	202	29.5	30.2	29.9	320	324	322
NPK	0.800	0.840	0.820	185	195	190	31.1	31.3	31.2	322	325	323
150% NPK	0.810	0.850	0.830	213	219	216	42.1	42.9	42.5	349	352	350
NPK + HW	0.830	0.830	0.830	198	200	199	30.5	32.7	31.6	297	330	313
NPK + Zn	0.830	0.870	0.850	197	199	198	29.9	31.4	30.7	301	316	309
NP	0.740	0.820	0.780	194	191	193	25.8	29.2	27.5	314	322	318
N	0.810	0.800	0.800	183	184	183	18.6	19.8	19.2	257	288	273
NPK + FYM	1.010	1.080	1.050	210	217	214	43.2	40.3	41.7	326	328	327
NPK – S	0.880	0.860	0.870	199	201	200	28.5	30.4	29.4	305	311	308
FYM	1.040	1.090	1.070	247	210	229	38.2	39.7	39.0	316	315	316
Control	0.800	0.810	0.800	191	198	195	20.3	20.1	20.2	309	318	314
Fallow	0.840	0.820	0.830	212	214	213	27.2	30.8	29.0	373	356	364
CD (0.05)	0.12	0.123	0.102	NS	NS	NS	6.7	7.0	3.45	NS	NS	NS
Initial	***0.79***			***107.6***			***19.6***			***364***		

Table.2 Effect of Long term fertilizer application on contents of Inorganic P fractions (mg kg^{-1}) in soil after rice during *rabi* 2010-11 and 2011-12.

Treatments	Saloid –P			Al- P			Fe – P			Ca - P		
	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean	2010	2011	Mean
50% NPK	4.7	4.8	4.8	71.9	83.8	77.9	30.6	37.1	33.9	342.4	353.5	348.0
NPK	5.5	5.7	5.6	81.8	92.5	87.2	32.9	39.8	36.4	361.3	373.0	367.1
150% NPK	6.1	6.3	6.2	86.5	97.8	92.2	36.8	44.5	40.6	396.5	409.4	402.9
NPK + HW	5.4	5.5	5.4	80.8	91.3	86.1	30.3	36.7	33.5	351.1	362.5	356.8
NPK + Zn	5.5	5.7	5.6	78.4	88.6	83.5	36.8	44.5	40.7	363.3	375.1	369.2
NP	4.2	4.4	4.3	68.1	76.9	72.5	33.1	40.1	36.6	360.2	371.9	366.1
N	3.6	3.7	3.7	56.9	64.3	60.6	21.6	26.2	23.9	228.9	236.3	232.6
NPK + FYM	6.9	7.1	7.0	97.7	110.4	104.0	40.0	48.3	44.2	440.4	454.7	447.6
NPK – S	5.0	5.2	5.1	84.5	95.5	90.0	31.9	38.6	35.2	396.5	409.4	402.9
FYM	5.4	5.6	5.5	70.9	80.1	75.5	34.6	41.9	38.3	345.2	356.4	350.8
Control	3.8	3.9	3.9	37.1	42.0	39.6	25.5	30.9	28.2	196.7	203.1	199.9
CD (0.05)	0.6	0.5	0.5	8.6	7.8	7.4	3.1	3.7	3.4	24.5	18.7	21.1
Initial	***3.2***			***35.6***			***20.9***			***188.9***		

Conclusions:

Application of FYM along with inorganic fertilizers improved the soil available nutrient status. Among the available nutrients, N, P showed a significant increase over the initial level, whereas depletion of K was observed in all the treatments under continuous cropping system. All the inorganic fractions of phosphorous (Saloid –P, Al –P, Fe –P and Ca –P) were increased from the initial value after ten years of long – term fertilizer and manure application under rice – rice cropping system.

References:

Abolfazli F, Forghani A and Norouzi M. 2012.Effects of phosphorus and organic fertilizers on phosphorus fractions in submerged soil. *Journal of Soil Science and Plant Nutrition.*12 (2), 349-362.

Krishna D, Ram S and Nandram.2007. Response to long – term use of NPK fertilizers and manures to P-fractions, soil properties and their relationship to yields of rice – wheat – cowpea cropping system on a Mollisol of Tarai, *Panthnagar Journal of Research*. 5(2): 108 -113.

Sharma S P, Subehia S K and Sharma P K.2002. Long – term effects of chemical fertilizers on soil quality , crop productivity and sustainability. Research Bulletin. Department of Soil Science, CSK HPKV. Palampur

Singh R P, Singh B and Dhillon N S. 2010. Effect of long –term differential fertilization on distribution of inorganic P fractions and P nutrition of wheat under maize – wheat sequence. *Journal of the Indian Society of Soil Science.* 58 (2): 237 -240.

Singh D, Singh J P, Mehla D S and Bharadwaj K K.2005. Effect of integrated use of inorganic fertilizers and organic materials on the distribution of different forms of nitrogen and phosphorous in soil. *Journal of the Indian Society of Soil Science.* 53(1):80 – 84.

Stalin P, Ramanathan S, Nagarajan P and Natrajan K. 2006. Long term effect of continuous manorial practices on grain yield and some soil chemical properties in rice –based cropping system. *Journal of the Indian Society of Soil Science.*54 (1): 30-37.

Subehia S K, Verma S and Sharma S P. 2005. Effect of long – term use of chemical fertilizers with and without organics on forms of soil acidity, phosphorous adsorption and crop yields in an acid soil. *Journal of the Indian Society of Soil Science.*53(3): 308-314.

Swarup A. 2002. Lessions from long –term fertilizer experiments in improving fertilizer use efficiency and crop yield. *Fertilizer News*. 47(12): 59 -66.