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Influence of long-term nutrient management on soil urease activity and yield of rice under flooded conditions

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Abstract
The effect long term nutrient management on soil urease activity and grain yield of rice under flooded conditions at Regional Agricultural Research Station, Maruteru, Andhra Pradesh, India was investigated. The five treatments were unfertilized (control), inorganic N fertilizer (90 kg ha^{-1}), inorganic fertilizer NPK @ 90-60-60 kg ha^{-1}, FYM @ 10 Mg ha^{-1} and inorganic fertilizer NPK @ 90-60-60 kg ha^{-1}, and FYM@ 5 Mg ha^{-1}. Among the treatments, significantly higher urease activity was found in NPK fertilizer and FYM followed by FYM, Inorganic NPK, Inorganic N and control. The enzyme activity significantly increased up to panicle initiation stage of the crop growth and there after showed a decreasing trend. Further, NPK fertilizer and FYM recorded significantly higher rice grain yield of 6254 kg ha^{-1} followed by FYM (4923 kg ha^{-1}), inorganic NPK (4217 kg ha^{-1}), inorganic N (2728 kg ha^{-1}) and control (2143 kg ha^{-1}). A twofold of increase in urease activity was recorded at panicle initiation stage of the crop growth and was significantly correlated with TOC content of soils.

Keywords: Manures, fertilizers, urease and flooded conditions

Introduction
Intensification of rice cultivation to meet the demand for food by the increase in human population is imperative, especially in India where approximately 80% of rice is grown and consumed. In larger parts of Asia, rice is being grown under flooded conditions. Rice-rice cropping system is the most dominant cropping system adopted by the farmers in Southern part of India**.** Submerged soils ecosystems are predominantly anaerobic and are different from upland soils in several physical and biological properties (Adhya and Rao, 2005) [1]. Organic manures are used in rice cultivation serve as a carbon and energy source for proliferation of microorganisms, which may alter the activities of different soil enzymes. Incorporation of residues not only plays an important role in soil chemical and biological environments and also affects the nutrient availability to microorganisms and crop plants (Power and Legg, 1978) [11]. The present investigation was aimed at to study the effect of integrated nutrient management of application of organic manure and fertilizer on the activity of urease and grain yield of rice under submerged conditions.

Materials and Methods
The study was conducted at the experimental farm of the Andhra Pradesh Rice Research Institute and Regional Agricultural Research Station (APRRI-RARS), Maruteru, A.P., India (26.38ºN, 81.44ºE). Meanannual temperature is 27.2ºC and annual precipitation is about 1200 mm $yr^{-1}$of which 75-80% is received during June to October. The soil of the farm area has been developed from the deltaic sediments of Godavari River. The soil is an inceptisol with clay loam texture pH (1:2) 6.10, electrical conductivity 0.70 dSm^{-1}, total C 0.58%, available N (270 kg ha^{-1}), available P_2O_5(18 kg ha^{-1}), available K_2O (235 kg ha^{-1}).
The field experiment on intensive rice cropping was established in 1989 to assess the long-term impact of both organic and inorganic fertilizers on different soil physicochemical properties and crop yield under intensive rice cultivation where rice is grown in a rice-rice sequence. Generally, rice was grown in *kharif* and *rabi* seasons. Farm Yard Manure (FYM) at 5Mg ha^{-1} was applied before every wet season. The field was ploughed thoroughly and flooded 2-3 days before transplanting for puddling and levelling. Rice plants (25 d old seedlings) of *cv*. MTU-1061 were transplanted at a spacing of 20 cm x 10 cm with two seedlings per hill in

the field plots. The experiment was laid out in a randomized block design with four replicates each. The treatments used for investigations during kharif under long term trial *viz*., unfertilized (control), inorganic N fertilizer (90 kg ha^{-1}), inorganic fertilizer (NPK @ 90-60-60 kg ha^{-1}), FYM @ 10 Mg ha^{-1} and inorganic fertilizer NPK @ 90-60-60 kg ha^{-1} and FYM @ 5 Mg ha^{-1}. Water was maintained at 2 cm depth during vegetative and 5 cm depth during reproductive stage of the crop until ripening and was drained 10 days before harvest. The crop was given recommended agronomic practices and harvested at maturity.

Soil samples were collected during the cultivation period of two seasons of *kharif* (June-October) in the control plots and plots receiving FYM (Farm yard manure) and inorganic fertilizer over the 22 years. Individual soil core samples at a depth of 0-15 cm from the soil surface from five different places within individual replicated plots and mixed together to prepare a composite sample for the plot. Immediately after sampling, excess water was allowed to drain off, visible root fragments and stones removed manually and transferred to the laboratory for analyses of microbial biomass and soil enzyme activity. Moisture content of individual samples was determined gravimetrically in 10 g portions after drying at 105ºC for 48 h.

Urease activity

Urease activity was analysed in the soil samples collected at different stage of growth of rice crop by quantifying the rate of release of NH_4^+-N from the hydrolysis of urea as described Tabatabai and Bremner (1972) [13]. Grain yield of rice was recorded in the respective treatments at the time of harvest in both the seasons of study.

The data of two kharif (wet) seasons were compared. All data was recalculated on the basis of oven-dry soil weight and was analysed using two way ANOVA considering main treatments and assay time at specific periods of crop growth and individual character datasets were statistically analysed and mean comparison between treatments was established by Duncan's multiple range test (Gomez and Gomez 1984) [4]. Simple correlations between soil chemical and biochemical properties and interrelations between the enzymes were also worked out

Results and Discussion

Influence of Integrated nutrient management on Urease activity

The results of the study indicate d that the activity of urease was significantly influenced by the application of organic manure and fertilizers (Table 1). Urease activity ranged from 19.10 to 76.69 µg of NH_4^+-N released g^{-1} soil 2 hr^{-1}. Highest urease activity was recorded significantly at panicle initiation stage of the crop growth (76.69 µg of NH_4^+-N released g^{-1} soil 2 hr^{-1}) and thereafter showed a decrease at harvest. Through the cropping period, the treatment inorganic NPK + FYM recorded significantly higher activity of urease (55.16 µg of NH_4^+-N released g^{-1} soil 2 hr^{-1}) followed by FYM, inorganic NPK, Inorganic N and control. A two fold increase in urease activity was recorded at panicle initiation stage of the crop growth. Addition of organic materials brings about proliferation of microorganisms leading to increased enzyme activity (Lloyd and Sheaffe, 1973) [5]. Rhizosphere root exudates of the plants have been shown to be good substrate for microbial proliferation. In the study, probably there was no arresting of ureolytic organisms from proliferation. Rice plants can transfer oxygen through shoots to the roots and hence lack of oxygen may not be important (Ando *et al*. 1983) [2]. Further, rice plants can excrete cellular urease (Mahapatra *et al*. 1977) [6] which might be an additional source of urease. Increased urease activity with 100% NPK and FYM might be due to higher populations specifically of anaerobes and actinomycetes which are considered as dominant urea producers (Balamohan *et al*. 2013) [3].

Table 1: Urease activity in flooded rice soil as influenced by long term nutrient management and stages of crop growth (cv.MTU-1061) during kharif (mean data)

Treatment	Initial	Max. Tillering stage	Panicle Initiation stage	Harvest	Mean
	(µg of NH_4^+-N released g^{-1} soil 2hr^{-1})				
Control	19.10	28.98	44.16	28.08	30.08
Inorganic N fertilizer @ 90 kg ha^{-1}	24.27	38.75	51.02	31.65	36.42
Inorganic NPK @90:60:60 kg ha^{-1}	28.55	43.60	60.25	37.38	42.44
FYM @ 10 Mg ha^{-1}	32.23	47.83	68.28	42.26	47.65
Inorganic NPK 90:60:60 kg ha^{-1} + FYM @ 5 Mg ha^{-1}	36.55	59.12	76.69	48.29	55.16
Mean	28.14	43.66	60.08	37.53	
		S.E.M.+	C.D.		
Treatments		1.20	2.77		
Stages		1.09	2.23		
Treatments x Stages		2.45	5.03		

Influence of organic manures and inorganic fertilizer on grain yield of rice

The effect of long term nutrient management on the grain yield of rice indicated significant differences in the study (Table 2). Among the treatments, the NPK and FYM treatment has recorded significantly higher grain yield (6254 kg ha^{-1}) followed by FYM (4923 kg ha^{-1}), inorganic NPK (4217 kg ha^{-1}), inorganic N (2728 kg ha^{-1}) and control (2143 kg ha^{-1}). Similarly, in the study, the total Organic Carbon (TOC) was significantly higher in NPK+ FYM (1.02%) followed by FYM (0.94%), NPK (0.81%), nitrogen alone (0.69%) and control plot (0.58%). Similarly, Majumder *et al*. (2008) [7] reported the results of 19-year old long term trail under Rice-wheat cropping and stated that with only NPK fertilization the soil organic carbon of the soil is just maintained while NPK along with organics increased soil organic carbon by 24.3% over the control.

Table 2: Influence of long term fertilization on grain yield of rice under kharif season (mean data)

Treatments	Grain yield (kg/ha)
Control	2143
Inorganic N fertilizer @ 90 kg ha^{-1}	2728
Inorganic NPK @90:60:60 kg ha^{-1}	4217
FYM @ 10 Mg ha^{-1}	4923
Inorganic NPK 90:60:60 kg ha^{-1} + FYM @ 5 Mg ha^{-1}	6254
Mean	4053
S.E.M.+	113
C.D.	324

Relationship between enzyme activity

Enzyme activities of soils are usually correlated with Total Organic Carbon (TOC) content (Taylor *et al*., 2002) [14]. There is a correlation of 0.884** was noticed between urease activity and TOC of soils. In addition, the higher organic matter levels in the FYM treatments may provide a more favourable environment for the accumulation of enzymes in the soil matrix, since soil organic constituents are thought to be important in forming stable complexes with free enzymes (Marx *et al*., 2005) [10]. Similar relationship between organic carbon and urease activity was reported by Raju *et al*. (2013) [12] and Mandal *et al*. (2007) [8].

Conclusion

The study revealed that long term integrated nutrient management application of FYM and inorganic fertilizers (NPK) caused a significant increase in urease activity and grain yield of rice under submerged conditions thus maintaining the soil organic carbon.

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References

1. Adhya TK, Rao VR. Microbiology and microbial processes in rice soils. In: Sharma SD, Nayak BC, editors. Rice in Indian Perspective. Today and Tomorrow Printers and Publishers, New Delhi; c2005. p. 719-746.
2. Ando TS, Yoshida S, Nishiyana I. Nature of oxidizing power of rice roots. Plant and Soil. 1983;72:57-71.
3. Balamohan P, Rajendran P, Balachandar D, Karthikeyan S, Chendrayan K, Bhattacharya P, *et al*. Long-term nutrient management fosters the biological properties and carbon sequestrating capability of a wetland rice soil. Archives of Agronomy and Soil Science. 2013;59:1607-1624.
4. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. Wiley Interscience Publications, John Wiley & Sons, New York; c1984.
5. Lloyd AB, Sheaffe MJ. Urease activity in soils. Plant and Soil. 1973;39:71-80.
6. Mahapatra B, Patnaik B, Mishra D. The extracellular urease activity in rice roots. Current Science. 1977;45:80.
7. Majumder B, Mandal B, Bandyopadhyay PK, Gangaopadhyay A, Mani PK, Kundu KL, *et al*. Organic amendments influence soil organic carbon pools and crop productivity in nineteen year old rice-wheat agro-ecosystem. Soil Science Society of America Journal. 2008;72(3):775-785.
8. Mandal A, Patra AK, Singh D, Swarup A, Masto RE. Effect of long-term application of manures and fertilizers on biological and biochemical activities in soil during crop development stages. Bioresource Technology. 2007;98:3535-3592.
9. Mandal M, Rout KK, Purohit D, Maji P, Muneswar Singh. Evaluation of rice-rice cropping system on grain yield, chemical and biological properties of an acid Inceptisol. Journal of Indian Society of Soil Science. 2018;66(2):208-214.
10. Marx MC, Kandeler E, Wood M, Wermbter N, Jarvis SC. Exploring the enzymatic landscape: Distribution and kinetics of hydrolytic enzymes in soil particle-size fractions. Soil Biology & Biochemistry. 2005;37:35-48.
11. Power JF, Legg JD. Effect of crop residues on the soil chemical and nutrient management. In: Oshwald OWR, editor. Crop Residue Management Systems. ASAS Special Publication; c1978. p. 80-110.
12. Raju B, Rao PC, Reddy AP, Padmavathi P. Effect of various INM on yield, urease and dehydrogenase activity in safflower. Helix Journal. 2013;6:405-408.
13. Tabatabai MA, Bremner JM. Assessment of urease activity in soils. Soil Biology and Biochemistry. 1972;4:479-487.
14. Taylor JP, Wilson B, Mills MS, Burns RG. Comparison of microbial numbers and enzymatic activities in surface soils and subsoils using various techniques. Soil Biology & Biochemistry. 2002;34:387-410.