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Impact of soil properties and temperature on urease activity in rice soils

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Abstract
Soil is the main reservoir of nutrients from which plants absorb them directly for their growth and proper development. The biological activity of the soil is evaluated mainly on the basis of the activity of four enzymes: dehydrogenase, phosphatase, urease, and protease.The investigation of soil enzymatic activity is useful for assessment of its chemical degradation. The aim of the studies was determination of enzymatic activity (urease) of wet land rice soils. In direction to assess the influence of some physical and chemical characteristics wetland rice soils and temperature on urease activity, a lab experiment was carried out in department of soil science and Agricultural chemistry, Faculty of Agriculture, Annamalai University.Twenty three soil samples were selected from different wetland rice soils of veeranum ayacut in Chidambaram Taluk. Urease activities range from 100.1 to 372.2 and 325 to 664 µgNH_4released/g soil/2hr at 15° and 25°C, respectively. A significant positive correlation (r = 0.096 at 15°C and 0.126 at 25°C) was observed between urease activity and soil pH reaction by quadratic ** ** regression equations. Relation of organic carbon with urease activity was generally quadratic correlated highly significantly with urease activity, with r values of 0.008 and 0.038 at 15°C and 25°C, respectively. While soil total N and Clay content were best described by linear regression equations. However, some of r values debilitatedgradually with decline in temperature.

Keywords: nitrogen, rice, urease activity

Introduction
In developing countries, the greatest challenge is improving and sustaining agricultural productivity to enable the country to become self-sufficient in food production and improving economy of country. Urease (EC 3.5.1.5) was one of the first enzymes purified grown with either NH to homogeneity (Sumner, 1926), but it was not until 4 NO_3 or urea as sole N source was evaluated. Growth of plants receiving NH 1975. Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population. The demand for rice continuesto increase owing to continued growth of population. It is predicted that a 50 to 60% increase in rice production will be required to meet demand from population growth by 2025 (Zhang and Wang, 2005) [1]. Urea is one of the most important chemical N fertilizers and its application has been recently increased in middle east because of its low cost, ease in handling and high nitrogen content.

The use of enzyme activity measurements as indicators of soil functionality and thus as indicators of soil quality and activity of the microbes, has been extensively discussed. Soil urease (urea amidohydrolase) is involved in nitrogen mineralization and supplying nitrogen to plants from natural and fertilizer sources. The rate of urea hydrolysis depends on several factors such as soil type, organic matter content (OM), soil moisture content, CaCO3 content, temperature, level of salinity and alkalinity. Reports of the influence of some of soil properties on soil urease activities are inconsistent (OToole *et al*., 1082).The present investigation was conducted to assess the effects of some of soil properties and temperature on urease activity in wetland rice soils under research laboratory conditions.

Materials and Methods
The soil samples, which were used in study, were collected from various former field of wetland rice soils of veeranum ayacut inChidambaram atcuddalore district, Tamil nadu. The soil samples were taken 0-30 cm depth 23 soil samples were used in investigation. The soil samples were air dried ground and passed through a 2mm sieve and glass containers. Urea was applied in 150 kg N ha^{-1} as solution in these soils. Soil samples were subjected to 14 days incubation at 15 and 25*C. The soil physical and chemical properties were determined by means of appropriate methods. Urease activity was measured in 0.05 M Tris hydroxymethyl amino methane (THAM) buffer pH = 9.00 in soils according to the method of Tabatabai and Brenner. Simple liner and stepwise regression analyses were used for describing the relationships between urea's activity and soil physical and chemical properties.

Results and Discussion
The expressive statistical results of designated soil physio-chemical properties are given in Table 1. Soil properties wide-ranging with respect to soil particle size distribution, Organic carbon, Total nitrogen, CEC, EC and clay content. Ureas activities in two temperature in different rice soils are given in Fig. 1. Soil in this experiment, urease activity is excessive in high temperature. Similar results were stated by Cartes *et al*., 2009 [3] in chileian soils and OTool *et al*.,1982 [2] in Irish soils. While urease enzymes is a factor analysis urea, so for prevention of urease losing, so do not use it in high temperatures in rice soils it is recommended. Simple

linear correlation coefficients between urease and soil physico- chemical properties are shown in Table 2. Urease activity exhibited significant positive liner correlation with Total nitrogen (r=0.0166 and r=0.0557), clay content(r=0.007 and r=0.005) and Organic carbon(r=0.0386 and r=0.0021) at 15* and 25* C, respectively (Fig.2).Similarly the results reported by (Daial, 1975) the urease activity in Trinidad and lows soils were highly significantly related to Organic carbon, Total nitrogen and CEC of soils too. Pattnaik*et al*. 1999 reported that 79 to 80 % urease activity was extracellular and complexed by soil colloids. Such as positive relationship between urease activities and soil organic carbon content might be due to a higher level of microbial biomass and greater stabilization of extracellular urease by humic molecules. The significant correlation between urease activities and soil total nitrogen content may be an indirect consequence of significant correlation between soil organic carbon and total nitrogen (Baligar and Wright.1999). Urease activity showed quadratric correlation with soil pH (r=0.1263 and r=0.0969) and EC (r=0.0911 and r=0.004) at 15 and 25*C respectively (Fig.3). Resuts show that urease activity increased slowly, reached a maxiu within pH= 6 to 7 and then decreased rapidly to 8. The experiment conditions, maximum urease activities is within EC = 0.3 to 1.0 $dsm^{-1}$and than EC increase no problem in urease activities. Various results were reported on urease activity, EC and pH (Cookson and Lepiece, 1996) [7].

Seemingly urease activity of these paddy soils studied was mostly meticulous by Total nitrogen that is accompanying with Organic carbon.

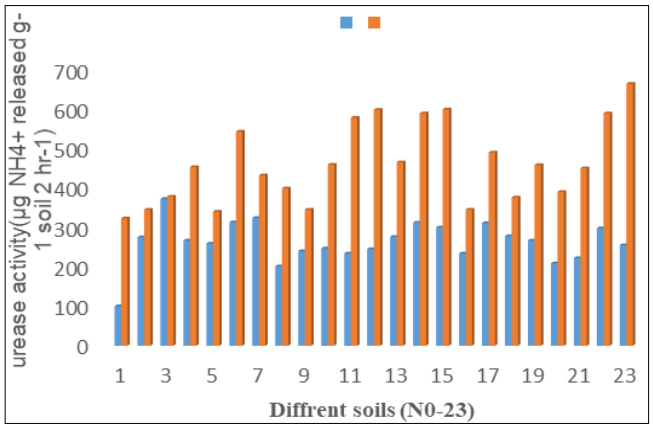
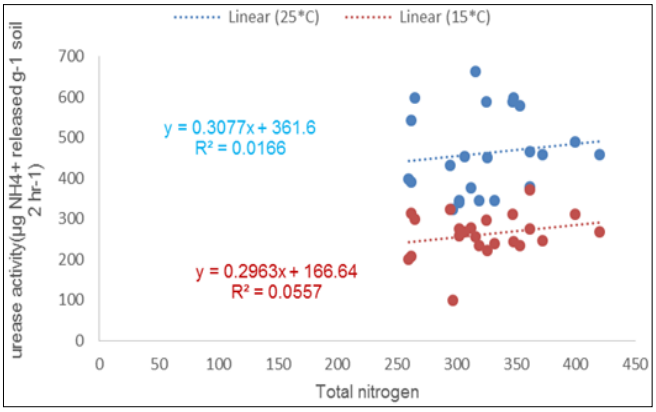
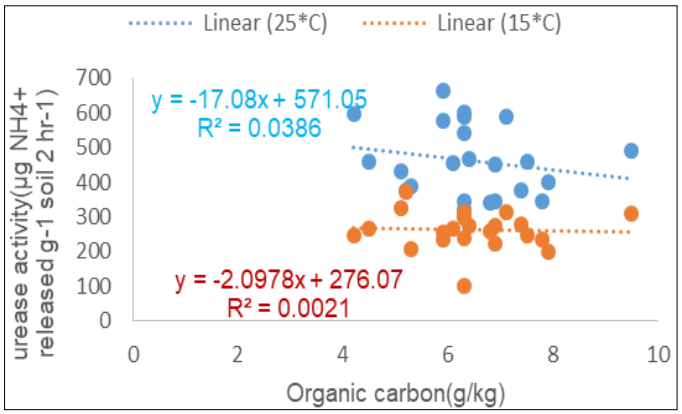


Fig 1: Urease activity in different paddy soils at two temperatures





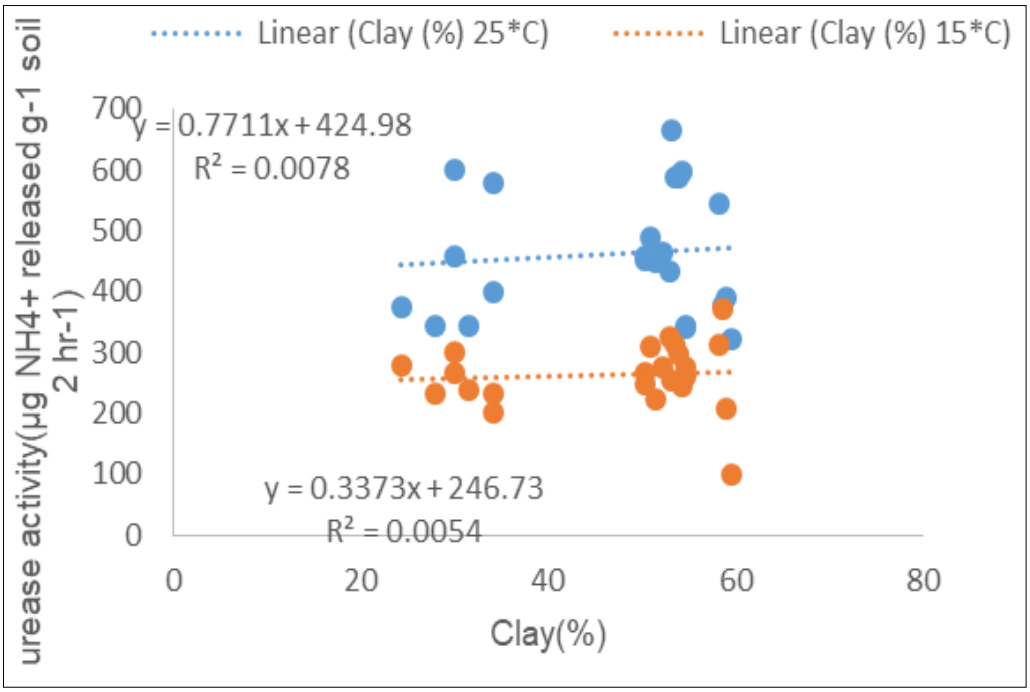


Fig 2: Linear relationship between urease activity with soil properties.

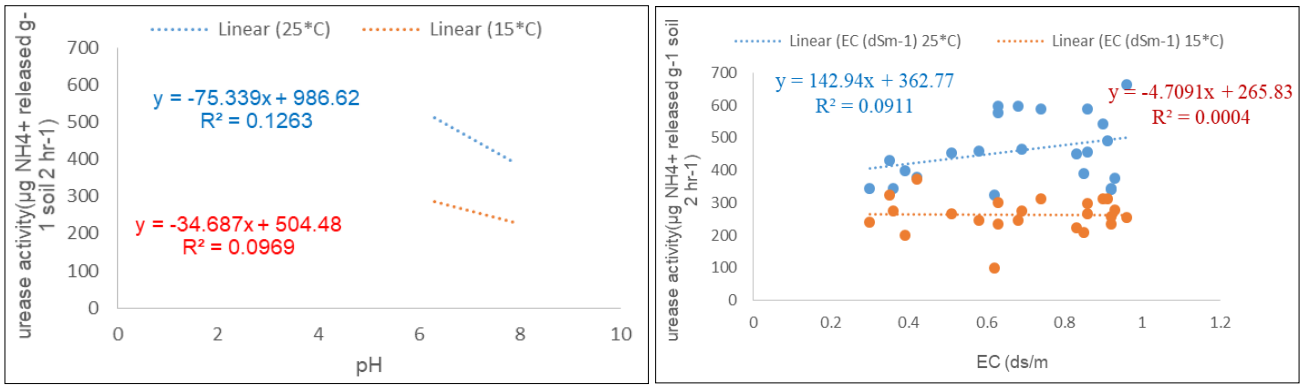


Fig 3: Linear relationship between urease activity with pH and EC

Table 1: Descriptive statistics for selected properties of wetland rice soils (n=23)

Soil properties	Unit	Mean	Max.	Min..
Clay	%	46.99	59.62	24.34
Silt	%	33.03	40.0	25.66
Sand	%	19.96	37.18	7.51
Electirical conductivity	dSm^{-1}	0.68	0.96	0.30
pH	-	6.97	7.90	6.30
Organicarbon	g kg^{-1}	6.43	9.5	4.2
Total nitrogen	Kg ha^{-1}	323	420	260
CEC	C mol p+ kg^{-1}	43.9	54.2	34.1
$CaCO_3$	%	2.91	8.21	0.48
Urease activity(UAc) 15* C	(µg NH4+ released g-1 soil 2 hr^{-1})	262.5	372.2	100.1
Urease activity(UAc) 25* C	(µg NH4+ released g-1 soil 2 hr^{-1})	461.21	664	323

Table 2: Simple linear correlation coefficients (r) of urease activity and soil properties

Temp.	Soil properties	Correlation coefficients	Equations
15*C	pH	0.0969	Y=-34.687x + 504.48
	EC	0.0004	Y=-4.7091x+25.83
	T.N	0.0551	Y=0.2963x+166.64
	OC	0.0212	Y= 17.08x+571.05
	Clay	0.0054	Y=0.3373x+24.73
25*C	pH	0.1263	Y=75.339x+986.62
	EC	0.9011	Y=142.94x+362.77
	T.N	0.0166	Y=0.3077x+361.6
	OC	0.0386	Y=2.0978x+276.07
	Clay	0.0781	Y=0.7711x+424.98

Conclusion

In this study have exposed a positive significant liner correlation between urease activity with Total nitrogen, clay content and correlation with Organic carbon, pH and EC. Urease activity is mostly controlled by Total nitrogen that is linked with organic carbon. In the soils studied urease activity is increased in high temperature.

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