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Protease Activity in Semi-Arid Soil

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A B S T R A C T

The aim of this work is to measure protease activity in semi-arid soils from different parts of Patan district, Gujarat State, India to explore the influence of physicochemical parameters. Protease activity measure from three sites from two depth was studied during specific duration. Soil protease activity was recorded difference in all sites and also show maximum activity at site 1 during November month. Physicochemical parameters also effect on soil protease activity.

Introduction

Protease activity is processed in the soil nitrogen cycle (Sardans *et al.*, 2008). Proteases catalyse the hydrolysis of protein to amino acids. In the soil, extracellular proteases are released by microorganisms, plants, animal excrements (Alef , 1995). This enzyme in the soil is associated with inorganic and organic colloids (Nannipieri *et al.*, 1996). Protease activities are affected by several biotic and abiotic factors. Extracellular Proteases enter the soil via microbial production and other sources, including plant root exudates, animal excrements, decomposition processes and leaching from agro industrial fertilizers (Alef, 1995). Bacterial and fungal Proteases are particularly important to the global carbon and nitrogen cycles in the recycling of proteins, and such activity tends to be regulated by nutritional signals in these organisms (Sims, 2006). The net impact of nutritional regulation of Protease activity among the thousands of species present in soil can be observed at overall microbial community level as proteins are broken down in response to carbon, nitrogen, or sulphur limitation (Sims and Wander, 2006). There is a need to study the properties and factors affecting naturally occurring enzyme complexes such as those involving Protease enzymes in the soil ecosystem as they may reveal some unknown role in soil fertility management.

Materials and Methods

Study Area

Patan district is located between 24.41 to 23.55 latitude and 71.31 to 72.00 longitudes.

The climate of the district is hot and dry. The district is surrounded by Banaskantha district on Northern side. On the Southern side is located the district of Kachchh and some parts of Surendranagar district. Mehsana district is on the Eastern site. The underground soil structure is mainly sandy up to thousand meters which is in the shape of bowl benefiting the district naturally with enough of ground water. The diurnal temperature ranges of the region between 45°C and 7°C. The average rainfall in this district is 600 ml, yet a small part of little run of kachchh extended to Sami, Harij, Radhanpur and Santalpurtaluka experiences serious scarcity of rain fall. The study area was divided into three main sites (1) Sujanipur village. (2) Boratvada village (3) Maktupur village

Soil Texture

To determine soil texture, soil was fractioned into gravel, corse sand, fine sand, silt and clay. The mean value of each fraction has been determined and according to the amount of each fraction within the site is represented Soil of all three sites showed sandy loam nature.

Soil Sampling

The entire district experiences semi-arid type of climate where in the aridity increases from East to West Rainfall decreases from East to West which creates definable climatic zones. Soil samples were taken from each site were collected at two months interval starting from June 2015 to May 2016. After collection of samples in sealed plastic bags they were immediately brought to the laboratory and kept at 4°C until analysed.

Soil Analysis

WHC of the soil is defined as the capacity of soil to hold water against the gravitational force. WHC is determined by the method describe by Misra (1968).Soil moisture from the sample determined from the weight loss after drying the soil sample in an oven at 105° C for 24 hrs and is expressed percentage oven dry weight of the soil using following formula.

$$\%\ \text{Soil moisture} = \frac{\text{loss in weight upon drying}}{\text{Fresh weight of soil}} \times 100$$

Soil particle size was analysed by Standard British Sieve method. Soil water paste was prepared taking 100 gm. air dry soil which was passed through standard sieves and each fraction thus obtained was oven dried and weighed. Soil pH was measured after preparing 1.2.5 soil water ratio which was kept overnight and then pH of soil was measured using pH meter. (Orion make) The soil organic carbon and soil total organic carbon was determined by modified wet digestion method describe by Walkley and Black. (APHA 21st addition, 1998). Total nitrogen from the soil sample was estimated by semi micro-kjeldahal method. (APHA 21st addition, 1998) and inorganic Phosphorous were measured by Ascorbic acid method.

Enzyme Assay

Protease enzyme activities which are involved in nitrogen transformation is done with following details given below. For the enzyme activities, the incubated sample was analyzed in triplicate and the average values were taken to minimize experimental error.

Results and Discussion

The activity of soil protease at three sites divergent in landscape and at two depths was studied during June 2015 to May 2016. The locations showed some difference in soil texture. Soil of sites 1 and 2 clay loam nature while site-3 recorded sandy silt texture. Table 1 shows set texture of all these sites. Table 2 show the physical characteristics of the soils under study. Table 3 illustrations the average valuesof pH, Organic-C, total-N and inorganic-P recorded at two depths throughout the year. Higher values of organ-C during dry period and ensuingdiminution during monsoon period may be recognised to highest activities bacterial and fungal community during summer season. During monsoon and post monsoon season competition for nutrients by plants and protozoal predation of microbes gives lower values of organic-C and total-N in soils (Robertson *et al.*, 1968, 1989, and Wardle and Parkinson, 1990). Table 4 shows soils Protease activity at all the three sites. Site-2 recorded maxim Protease activity.

Table.1

Soil enzyme	Soil gm	Substrate	REACTION	pH/buffer	Temp	Time	Reference
Protease	1	25 mg of sodium caseinate	Proteins or Polypeptides + $H_2O \rightarrow$ Amino Acids	1 8.1/0.1 mol L-1 tris	50	24	Ladd and Butler, 1972

Table.2 Soil Texture

Site	Gravel	Sand%	Silt%	Clay%
1	2	14	45	37
2	2	19	40	39
3	3	22	49	24

Table.3 Soil Physical Properties

Character	Sites		
	1	2	3
Color	Black	Brown	Brownish Black
Temp. c	24-34	24-35	19-33
% WHC	29.0±2.18	31.0±3.7	25.0±4.57
% Moisture	10.4±2.2	12.8±1.18	14.3±1.2

± = Standard deviation

Table.4 Soil Chemical Characteristics

Character	Depth (cm)	Sites		
		1	2	3
% Org.-C	0-10	1.11±0.59	1.45±0.54	0.73±0.41
	10-20	1.35±0.58	1.25±0.37	0.20±0.33
% Total N	0-10	0.07±0.04	0.08±0.04	0.04±0.04
	10-20	0.04±0.04	0.04±0.03	0.04±0.04
% Inorganic P	0-10	0.04±0.04	0.07±0.03	0.04±0.04
	10-20	0.04±.0.05	0.07±0.05	0.07±0.04
pH	0-10	7.59±0.05	7.88±0.05	7.37±0.05
	10-20	7.73±0.07	7.44±0.04	7.53±0.49

± = Standard deviation

Table.5 Protease activity in Soil

Month	Depth (cm)	Mg NH_3g^{-1} dry Soil $3h^{-1}$		
		Site-1	Site-2	Site-3
June-July	0-10	3.35±0.017	1.03±0.01	1.75±0.09
	10-30	1.18±0.004	1.70±0.58	0.43±0.01
Aug-Sept	0-10	0.33±0.043	1.05±0.41	0.49±0.13
	10-30	0.39±0.007	0.93±0.11	0.34±0.10
Oct-Nov	0-10	3.34±0.43	1.89±0.01	0.54±0.14
	10-30	1.77±0.73	1.51±0.74	0.14±0.03
Dec-Jun	0-10	0.04±0.04	0.99±0.08	0.33±0.04
	10-30	0.43±0.58	0.75±0.04	0.08±0.01
Fab-March	0-10	0.03±0.04	0.83±0.33	0.05±0.04
	10-30	0.45±0.04	0.37±0.37	0.01±0.00
April-May	0-10	0.04±0.01	0.53±0.35	0.03±0.01
	10-30	0.40±0.04	0.15±0.13	ND

± = Standard deviation

The activity was recorded to be higher during monsoon and post monsoon season. This may be attributed to activities of diverse microbial community's especially fungi during this period. As decreases the activity of Protease remarkably when decreased soil moisture.

Site-1 recorded highest protease activity during Post monsoon season. The overall turnover of nitrogen was more at site-2 indicating more persistent protease activity due to clayey texture. Site-1 and 2recorded higher activities indicating soil texture affects the activity of Protease in these soils.

Lower Protease activity in summer season shows adverse effect of high temperature on protease activity Studies showed that soil physical and chemical properties have appreciable effect on soil Protease activity. Soil texture may also have positive effect on protease activity as higher clay content may protect the enzyme from inhibitory effects of soil edaphic factors.

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