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Influence of enzyme activities on microsite, depth and grazing of forage soils of North Gujarat

Ratna Trivedi¹, S.A.Bhatt^{*2}

¹Department of Microbiology, Shree Ramkrishna Institute of Applied Sciences,
M.T.B. College Campus, Athwalines, Surat - 395 001, Gujarat, (INDIA)

²Department of Life-Sciences, Hemchandracharya North Gujarat University, Patan - 384 265, (INDIA)

E-mail: drratnatrivedi@gmail.com; shreyas_bhatt@yahoo.co.in

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ABSTRACT

The enzyme status of soil influences mineralization kinetics, and thus, the supply of nutrients to plants. We quantified urease, asparaginase, glutaminase, and phosphatase, activity in a sagebrush/grass ecosystem of north Gujarat. Enzyme activity was evaluated by depth (0 to 5 cm, 5 to 10 cm, 10 to 20 cm), microsite, and treatment (grazed and ungrazed). For most enzymes evaluated, there was a significant depth x microsite interaction. In general, enzyme activity declined with depth. Moreover, the interspace microsite often had the lowest enzyme activity among the other microsites. Depending on soil depth and microsite, the grazing treatment significantly reduced urease, asparaginase, and alkaline phosphatase activity compared to the ungrazed treatment. Enzyme activity is an important soil attribute and may serve as a robust measure of soil health.

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KEYWORDS

Enzyme activities;
Mineralization;
Microsite;
Forage soils.

INTRODUCTION

Soil is a critical component of the Earth's biosphere. From food production, degradation of toxic compounds, and as a medium for the geochemical recycling of many elements, proper management of soil is crucial for the continued prosperity of humans. Yet, given that most soils of the world have only been intensively cultivated and grazed for a relatively short period of time, there are concerns whether our soil resources are sustainable^[5]. Scientists have recently attempted to quantify soil health or quality as an index of sustainability^[4]. One potentially important soil attribute that may be a good

proxy for soil health is enzyme activity^[3,8] because it is an integration of life processes occurring within the soil. The study was conducted to ascertain how several common soil enzymes vary by soil depth, soil microsite, and grazing in a sagebrush/grass plant community.

MATERIALS AND METHODS

Sample site

Samples were collected from different part of North Gujarat which is semi-arid region of Gujarat. As representative of ungrazed plots plots were collected from Bortwade (A1), Naliya (A2) whereas representative of

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open grassland were of Adiya (B1), Sabdalpura (B2). Soil (four replicates) was collected from grazed and ungrazed treatment plots. Three depths were sampled (0 to 5 cm, 5 to 10 cm, and 10 to 20 cm). Microsites sampled on the grazed plot included sagebrush, (ARTR), cheatgrass, (BRTE), and noncryptogamic barren shrub interspaces (INTER). Microsites sampled in the ungrazed plot included crested wheatgrass, (AGDE), cryptogamic crust covered shrub interspaces (CRPTO), cheatgrass (BRTE), and sagebrush (ARTR).

Enzyme assays

The soils were returned to the laboratory where they were air dried and sieved to remove material greater than 2 mm in size. The soils were then stored in paper bags in the refrigerator prior to the particular enzyme assays. Assays were completed within 2 weeks. Enzyme activity procedures are as outline in Tabatabai^[9]. Three enzymes that cleave amine groups (amidohyrolases) were evaluated: asparaginase, urease, and glutaminase. These assays are based on the determination of ammonium released when buffered soil (5 g) is incubated individually with known amounts of the substrates, L-glutamine, L-asparagine, or urea at 37°C for 2 hours. After incubation, cleaved ammonium is extracted with 2 M KCl containing AgSO₄ to stop enzyme activity. Ammonium present in the original soil and ammonium cleaved due to non-

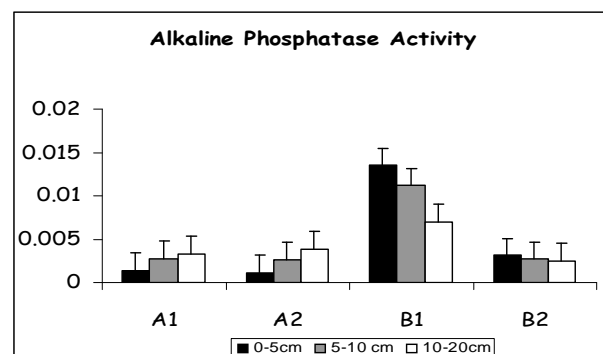
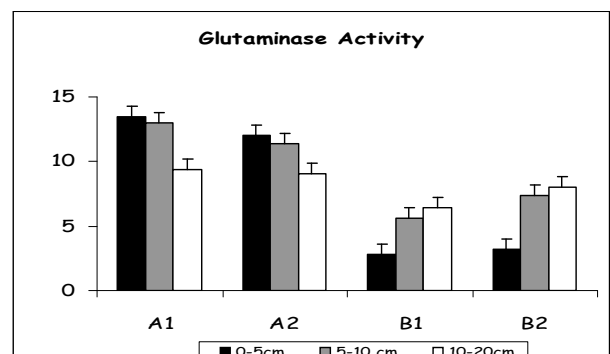
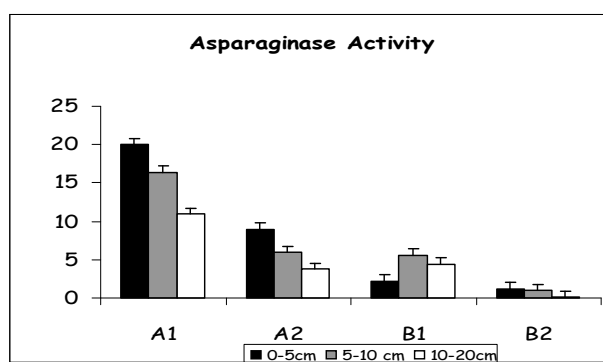
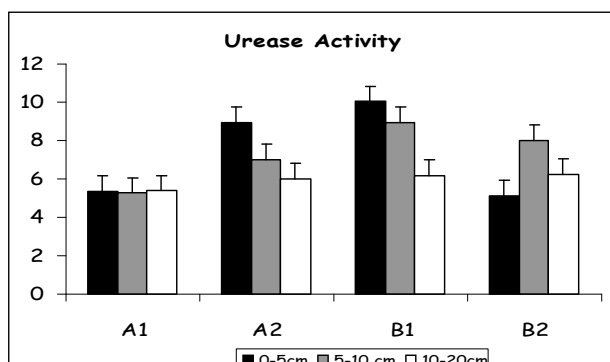
enzymatic processes are subtracted out via running a blank. Ammonium is quantified using phenet method. Quantification of acid and alkaline phosphatase activity is based on the cleaving of the phosphate group attached to *p*-nitrophenyl. One g of THAM-buffered soil is incubated with the appropriate substrate at 37°C for 1 hour. The *p*-nitrophenyl remaining is extracted with KCl and quantified colorimetrically.

Statistics

For each individual enzyme, data were analyzed using a fixed effect, two-way analysis of variance with unequal replication for depth and microsite. A separate two-way analysis of variance was performed on depth and treatment for microsites BRTE and ARTR. For the prepared graphs, variance of data is shown by standard error about the mean.

RESULTS

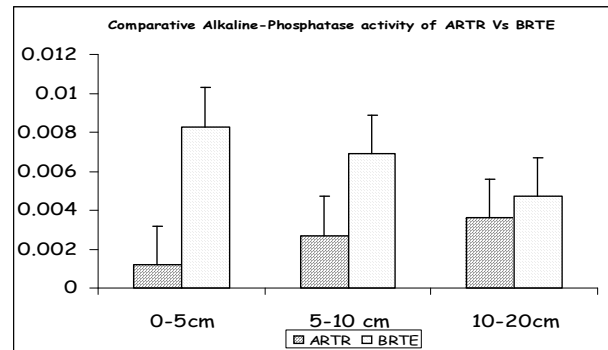
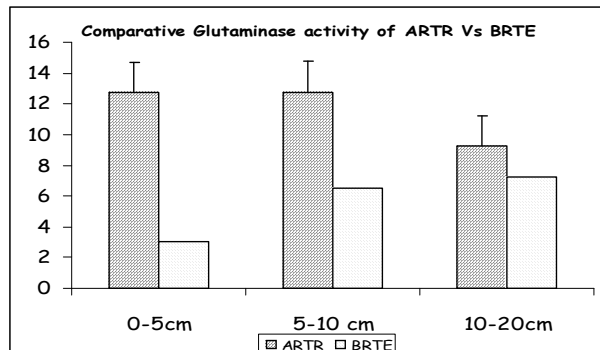
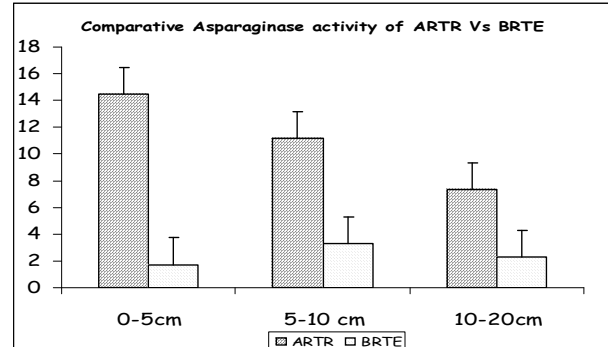
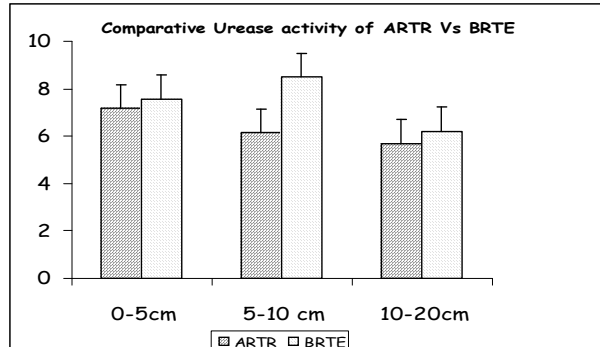
There was a significant ($P = 0.05$) depth x microsite interaction for enzyme activities of urease, asparaginase and glutaminase. Urease activities was more variable than asparaginase and glutaminase activity. Moreover, the ARTR microsite generally has the lowest enzyme activities among the microsites and the most inconsistent trend in enzyme activities with depth.



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Urease activity displayed a increase trend with depth for the ARTR and BRTE microsites, but Asparaginase activity for the BRTE site significantly decreased with depth. Asparaginase and Glutaminase were the only

enzymes whose activity consistently declined with depth. The BRTE microsite had the highest enzyme activities, but only statistically higher in the 0- to 5-cm depth increment for urease and Alkaline phosphatase.



Alkaline phosphatase had significant main effects for depth and microsite. Enzyme activity declined significantly with depth in BRTE. The ARTR microsite had the most activity followed the least enzyme activity. Urease activities was influenced by a significant microsite x treatment interaction. In the 0- to 5-cm depth increment, the grazed plot had significantly less enzyme activities of Alkaline phosphatase ARTR microsite compared to the ungrazed BRTE microsite.

DISCUSSION

Plant microsite did significantly affect enzyme bioassays, which has been reported in the literature^[7,8]. In general, enzyme activity was highest in the surface soil (0 to 5 cm). Burke^[2] and Bolton^[1], whose experiments were also conducted in a sagebrush ecosystem, found similar results. For BRTE microsite enzyme activity was least in the 0- to 5-cm depth increment. The lack of higher plant life, which would afford some moderation of the intense desert sun and engender greater microbial numbers, may explain these findings. Grazing-induced

reduction of enzyme activities has been reported in the literature^[6]. Given enzyme activity of soil is both a microbial (largely) and a plant mediated process^[10], one would suspect that grazing has reduced those microbes and higher plants that produce urease, asparaginase, and alkaline phosphatase. This conclusion is of course complicated by the fact that, in the shrub interspaces where the grazing effect is most pronounced, the soil lacks well-expressed cryptogamic organisms. The large reduction in urease activity on grazed BRTE microsites is perplexing; however, it seems reasonable to speculate that grazing of cheatgrass may have reduced root elongation into the 10- to 20-cm depth increment. It seems plausible that the grazing reduction of the amidohydrolases urease and asparaginase could potentially reduce N mineralization kinetics^[6]. Likewise grazing-induced reduction of phosphatase could reduce P availability.

REFERENCES

- [1] H.Bolton Jr., J.L.Smith, S.O.Link; Soil Biology and Biochemistry, **25**, 545-552 (1993).

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- [2] I.C.Burke; Ecology, **70**, 1115-1126 (1989).
- [3] R.P.Dick; 'Soil Enzyme Activities as Indicators of Soil Quality'. In: Defining Soil Quality for a Sustainable Environment. SSSA Spec. Publ. 35. Madison, WI: Soil Science Society of America, 107-124 (1994).
- [4] J.W.Doran, Others, (Eds); 'Defining Soil Quality for a Sustainable Environment'. SSSA Spec. Publ. 35. Madison, WI: Soil Science Society of America, 244 (1994).
- [5] D.J.Hillel; 'Out of the Earth, Civilization and the Life of the Soil'. New York: The Free Press, 321 (1991).
- [6] J.A.Holt; Applied Soil Ecology, **5**, 143-149 (1997).
- [7] J.L.Neal Jr.; Canadian Journal of Soil Science, **53**, 119-121 (1973).
- [8] A.Saviozzi, R.Levi-Minzi, R.Cardelli, R.Riffaldi; Plant and Soil, **233**, 251-259 (2001).
- [9] M.A.Tabatabai; 'Soil Enzymes'. In: Methods of Soil Analysis, Part 2, Microbiological and Biochemical Properties. Madison, WI: Soil Science Society of America, 775-833 (1994).
- [10] R.L.Tate; 'Soil Microbiology', New York: John Wiley & Sons, 398 (1995).