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# Measurement of Microbial Biomass-C, N, and P from Semi-arid Soil of Patan District (Gujarat), India

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**A B S T R A C T**

Microbial biomass C, N and P are determined in soil at two depth 0-10 cm and 10-20 cm of two distinct sites monthly over a period of 12 months. The selected sites having different topological characteristics. The concentration of C, N and P in soil was found to decrease with increasing depth. The microbial activities were influenced by environmental factors and soil abiotic characteristics. The turnover of Carbon, nitrogen and phosphorus in soil quite low feasibly because of lower nitrogen and phosphorus level.

## Introduction

Aridity has increased day by day over most of land and recent global warming has accelerated land drying (Jiao *et al.,* 2016). Due to decreased precipitation and higher evaporation, worldwide drought could increase, accelerating this process that cause land degradation and desertification.

Soil microbial biomass is a significant ecological indicator which serve as both source and sink of nutrients that are readily available for plant growth. Soil Microorganisms play a crucial role in ecological functions like breakdown of organic matter, the cycling of nutrients, transformation, mineralization and many more ecosystem process (Ettema and Wardle, 2004).

In an ecosystem, the elements carbon(C), Nitrogen and Phosphorus affects biogeochemical cycling and significant ecological processes that are crucial for the synthesis and conservation of substances (Jiao *et al.*, 2016). Additionally, the interaction of soil C, N and P elements in the elements cycle is extremely important for the productivity and carbon sequestration capability of grassland and forest ecosystems (Cleveland and Liptzin, 2007).

Measuring Microbial biomass has two key benefits: first, it serves as a catalyst for the transformation of nutrients given to the soil and second, it represents a labile reservoir of nutrients such as a carbon, nitrogen and phosphorous. The turnover rates of these nutrients through Microbial biomass determine their availability (Van Veen *et al.*, 1987). Increase in temperature and aridity do not always coincide with change in the concentrations of elements like C, N and P in soils, which could result in an elemental imbalance that is harmful to plant growth and productivity (Mc Gill *et al.*, 1986.)

According to Patra (1990), Microbial biomass Carbon, Nitrogen and Phosphorous showed seasonal fluctuation in forest and savanna vegetation in temperate soil. Studies on Microbial biomass and their nutrient content have expanded as a result of increased awareness of the crucial role played by microorganisms in health of ecosystems (Anderson and Domsch, 1987).

## Materials and Methods

### Sample Collection

Soil sample were collected from two different sites and at two different depths viz., 0-10 cm and 10-20 cm. The sites are arid to semi-arid in nature. Sample were collected in sterile polythene bag and stored in refrigerator for further analysis.

### Measurement of Microbial biomass- C, N and P

The collected soils from field were air dried, Sieves and immediately analyse for C, N and P by fumigation Extraction method (Brookes, 1985). Fumigated soils were incubated in dark condition for 18-24 hrs. After incubation the flasks were rotate on rotary shaker for 1 hr. and got extraction. Collected extraction carry for further analysis. From the collected Extracts estimate Organic carbon by Walkey and Black method and P were measured by ascorbic acid method. Nitrogen was measured using Micro-Kjeldahl method (Jackson, 1958). Soil pH was measured using glass electrodes.

## Results and Discussion

The textural difference was observed in two different Sites of Patan district. pH of both sites was recorded alkaline. Nitrogen and phosphorus were recorded low compare to organic carbon of both sites (see Table 1). The main indicators of changes in organic matter quality and quantity as well as it associated dynamic of significant components like C, N and Pare biomass and microbial respiration (Bradley and Fyles, 1995).

### Extracted C, N and P flush

The flush of decomposition was calculated by this formula:

$E_C$ = OC from fumigated soil – OC from non-fumigated soil

$E_N$ = Total Nitrogen from fumigated soil-Nitrogen from non-fumigated soil

$E_P$ = Phosphorus from fumigated soil – Phosphorus from non- fumigated soil.

The extractable carbon was recorded higher during the month of May-June at both sites (See table 2) While at site II the flush of extractable C sharply increased during Monsoon and Post Monsoon season i.e., during July to October.

This may be result of the presence of large population of Microorganisms during these seasons and also intense competition between them and plants for nutrients. In case of extractable C of site, I remain same during the month of November and February. The Month May-June recorded highest turnover of biomass C at both sites.

This might be because there is less competition for nutrient at this time, through the investigation the flushes of extractable C at 0-10 cm depth were higher compare to 10-20 cm depth during the study.

## Biomass-C

Biomass C was not much increased during the July to October but during the May-June turnover of biomass-C was almost double it means good activities of Microorganisms at 10-20 cm.

This suggest that microorganisms are most active during dry period. The extractable-C at both sites slightly decreased during the month of January and February, it indicates reducing the activities of soil microorganisms.

## Biomass N

Table 3 shows the extractable and biomass N of both sites at both depths. The site I reported a larger turnover of Biomass-N during the month of September while site II recorded higher turnover during same month.

Site I recorded higher turnover of MB-N during month of November. The proportion of extractable nitrogen increased significantly after November and continue up to May and June. This may be due to less competition from plants for nitrogen absorption from November to June. Microbial activity also increases due to breakdown of plant biomass.

**Table.1** Properties of Soil

| Site | Texture | pH | OC(%) | Total N (%) | Inorganic P(%) | C:N Ratio | N:P Ratio | WHC | FC |
|---|---|---|---|---|---|---|---|---|---|
| I | Clayey loam | 7.2 | 0.79 | 0.05 | 0.019 | 15.8 | 2.63 | 33.5 | 55.91 |
| | Slity | | | | | | | | |
| II | Sandy | 7.4 | 0.69 | 0.04 | 0.016 | 17.25 | 2.5 | 29.2 | 49.36 |

**Table.2** Extractable Microbial Biomass-C µg/g

| Month | Depth | site I | | site II | |
|---|---|---|---|---|---|
| | | Ec | Bc | Ec | Bc |
| Nov.-Dec. | 0-10 cm | 63.01 | 162.21 | 81.23 | 188.98 |
| | 10-20 cm | 48.52 | 98.31 | 43.21 | 92.36 |
| Jan-feb | 0-10 cm | 58.54 | 155.36 | 68.33 | 175.012 |
| | 10-20 cm | 39.66 | 110.23 | 34.52 | 109.36 |
| mar.-April | 0-10 cm | 65.78 | 179.28 | 62.33 | 180.35 |
| | 10-20 cm | 52.58 | 135.32 | 45.32 | 125.98 |
| May-June | 0-10 cm | 82.36 | 224.98 | 80.25 | 209.37 |
| | 10-20 cm | 66.79 | 156.02 | 48.25 | 129.52 |
| July-Aug | 0-10 cm | 35.89 | 105.98 | 35.21 | 105.2 |
| | 10-20 cm | 25.69 | 66.32 | 22.39 | 58.36 |
| Sept-Oct | 0-10 cm | 45.39 | 135.36 | 45.21 | 118.98 |
| | 10-20 cm | 35.36 | 110.74 | 30.98 | 81.08 |

**Table.3** Extractable Microbial Biomass-N µg/g

| Month | Depth | site I | | site II | |
|---|---|---|---|---|---|
| | | EN | BN | EN | BN |
| Nov.-Dec. | 0-10 cm | 26.14 | 61.24 | 18.06 | 37.48 |
| | 10-20 cm | 21.23 | 56.17 | 8.55 | 15.26 |
| Jan-feb | 0-10 cm | 38.23 | 83.36 | 40.58 | 93.53 |
| | 10-20 cm | 25.14 | 51.25 | 28.96 | 65.24 |
| mar.-April | 0-10 cm | 48.36 | 97.45 | 45.36 | 98.96 |
| | 10-20 cm | 26.98 | 63.24 | 29.66 | 65.87 |
| May-June | 0-10 cm | 45.12 | 109.71 | 45.69 | 108.69 |
| | 10-20 cm | 33.45 | 76.24 | 32.69 | 75.29 |
| July-Aug | 0-10 cm | 4.95 | 12.01 | 8.63 | 7.52 |
| | 10-20 cm | 3.98 | 7.02 | 0.98 | 0.78 |
| Sept-Oct | 0-10 cm | 7.69 | 18.69 | 19.06 | 38.41 |
| | 10-20 cm | 10.99 | 25.09 | 6.99 | 18.36 |

**Table.4** Extractable Microbial Biomass-P µg/g

| Month | Depth | site I | | site II | |
|---|---|---|---|---|---|
| | | EP | BP | EP | BP |
| Nov.-Dec. | 0-10 cm | 2.25 | 6.39 | 0.89 | 2.69 |
| | 10-20 cm | 2.01 | 5.55 | 0.32 | 0.84 |
| Jan-feb | 0-10 cm | 3.08 | 9.05 | 4.01 | 9.36 |
| | 10-20 cm | 2.65 | 5.45 | 2.98 | 7.5 |
| mar.-April | 0-10 cm | 4.5 | 8.65 | 3.98 | 9.5 |
| | 10-20 cm | 2.69 | 5.47 | 3.02 | 7.51 |
| May-June | 0-10 cm | 3.89 | 10.36 | 3.85 | 9.65 |
| | 10-20 cm | 2.9 | 8.21 | 2.6 | 7.59 |
| July-Aug | 0-10 cm | 0.99 | 2.98 | 0.87 | 1.56 |
| | 10-20 cm | 0.15 | 0.98 | 0.12 | 0.41 |
| Sept-Oct | 0-10 cm | 1.73 | 5.21 | 0.98 | 1.69 |
| | 10-20 cm | 0.98 | 2.36 | 0.59 | 1.52 |

**Table.5** Relationship between extractable C, N and P

| Month | site 1 | | site 2 | |
|---|---|---|---|---|
| | EcEN | C:N of Biomass | EcEN | C:N of Biomass |
| Nov.-Dec. | 2.98 | 2.56 | 3.89 | 4.97 |
| Jan-feb | 1.56 | 1.89 | 1.58 | 1.98 |
| mar.-April | 1.48 | 1.89 | 1.58 | 1.87 |
| May-June | 1.98 | 2.28 | 1.74 | 2.012 |
| July-Aug | 7.75 | 9.25 | 13.02 | 14.26 |
| Sept-Oct | 6.23 | 7.56 | 13.21 | 15.21 |

## Biomass P

The Extractable-P and biomass P value depicted in table4. The site I shows higher EP and BP during month from July to December. In other hand during other months both sites recorded similar value of extractable-P. The overall turnover of biomass N and P were very low compared biomass-C.

## Relation between $E_C$, $E_N$ and $E_P$

Table 5 depicted ratio of EC, EN and EP of both sites. During the month of July the C/N ratio of biomass was highest and it decreased after December, it means that MB-N was high during this period compared to MB-C of both sites.

The ratio of N/P of biomass of both sites concluded that, turnover of biomass-N was high compare to biomass-P. The ratio of BC/BN and BC/BP were significantly related.

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