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A Comparative Study on pH of Soil From Different Areas of Mumbai Region, India

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ABSTRACT:
Mumbai is situated at the top of the Ulhās River on the western coast of India. It is covered by the Arabian Sea to the west. In Mumbai sandy soil is predominantly present due to its proximity to the sea. The present study was conducted during the winter season month of March and April 2017-2018 from inhabited areas. Soil samples were collected from different areas of Mumbai. Soil pH and moisture content in soil were measured by using the standard method. The standard deviation was conducted on all variables. Our study showed that the pH value is in the alkaline range in different areas of Mumbai. It could be due to the decreased ground level of water, industrialization, pollution, inhabitation, and heavy construction in the area. Our study suggests that alkaline soils increase the salt content, could lower nutrition and mineral absorption leading to difficulty in taking up agricultural production.

Keyword: *Alkaline soil, moisture, pH, water conservation*

INTRODUCTION

Soil acidity, neutrality and alkalinity is measured by pH (negative log of the activity of the hydrogen ion in an aqueous solution). The pH of neutral soil is 7.0. Soil with low pH (less than 7.0) is known as acidic soil, whereas soil with high pH (more than 7.0) is known as alkaline soil (Mumbai Farmer). NRCS (Natural Resources Conservation Service), Department of The United States classifies the soil pH as Ultra acid soil pH if less than 3.5; Extremely acid soil pH 3.5 to 4.4; Very strongly acid soil pH 4.5 to 5.0; Strongly acid soil pH 5.1 to 5.5; Moderately acid soil pH 5.6 to 6.0; Slightly acid soil pH 6.1 to 6.5; Neutral soil pH 6.6 to 7.3; Slightly alkaline soil pH 7.4 to 7.8; Moderately alkaline soil pH 7.9 to 8.4; Strongly alkaline soil pH 8.5 to 9.0; Very strongly alkaline soil pH more than 9.0 (Soil pH).

The moisture content of the soil is an indicator for the amount of water in soil. This water is present in the pores of the soil in liquid and vapour phases (Scott and Maitre, 1998). According to Zárate-Valde*et al.* (2006) observed, that moisture content and pH of soil are directly proportional to each other, by conducting an experiment where pH of dry soil changed on addition of water and moisture of soil and its pH increased simultaneously. An *et al.,* (2018) reported that water evaporation rate is directly proportional to increase in initial water content and dry density. Tamea*et al.,* (2009) concluded that soil moisture content and groundwater fluctuation are the main controlling factor for overall ecosystem dynamics. Zhang *et al.,* (2018) suggested that high depth of groundwater has a negative effect on soil moisture.

According to McCauley et al., (2017) pH of soil is influenced by both acid and base-forming cations. Hydrogen (H^+), Aluminium ($Al3^+$), and iron ($Fe2^+$ or $Fe3^+$) are acid forming cations, whereas base-forming cationsare calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+) and sodium (Na^+). Nutrition supply ability of soil is affected by cation and anion Exchange capacities and this is influenced by soil pH (McCauley et al., 2017; Merry, 2010; Plant Nutrition

and Soil Fertility). pH of soil also correlate with plant nutrition due to its control on availability of nutrients to plants. Nutrients must be available to plants for absorption; conditions such as high alkalinity render them unavailable for plant even though they may be present in soil in high concentration (Soil pH).

MATERIALS AND METHODS

The study area was based on inhabited area in Mumbai. The sample collection sites are situated in Airoli (Ganesh Nagar), Thane (Kishan Nagar), Mulund (G. V. Scheme), Bhandup, Airoli (Sector 20), Kurla, yashodhannagar, Kalwaand Airoli (Sector 19). The study area has characteristically uniform temperature, little wind and intermittent sunshine and clouds. The climatic condition is representative of the high temperatures, between 29ºC and 36ºC.

Samples we recollected using metal spade from the depths intervals of 0-5cm, 5-10cm and 10-15cm of soil. At each area, three soil samples were taken within the depths intervals and composited as one sample. The samples were then transported in sealed aluminium foil to the laboratory and once in the lab, they were freeze dried. Only soil fractions of 2mm were used for further analysis.

To avoid any contamination all laboratory equipment's used were washed with phosphate-free detergent. The equipment's then rinsed two times with double-distilled water and left semi closed to dry at room temperature. pH was measured using universal indicator and pH meter. Moisture content of the soil was expressed in percentage by using following formula:

$$\omega = \frac{M\omega}{Ms} X\ 100$$

ω = moisture content of soil (%)
Mω= initial mass of moist soil (g) minus mass of oven-dried soil (g)
Ms = the soil's oven-dried mass (g)

RESULTS AND DISCUSSION

Soil quality is most important factor for agriculture and pH is one of important factor to measure soil quality. Change in pH has drastic effect on soil which may impact agriculture production as certain crops grow only at specific pH. The soil samples taken from Mumbai suburban areas show alkaline pH in range 8-8.5 (Table 1).High pH value can stop nutrients from being available to plants. Therefore, alkalinity makes it difficult to grow certain plants. Often alkaline soils occur in the landscape as a result of calcium carbonate-rich building materials (i.e., concrete, stucco, etc.) that may have been left in the soil following construction. Soils that contain limestone or seashells are also usually alkaline in nature (Van diver, 2014).

All the locations of study areas are densely populated and near to creek (within range of 3 KM). The alkaline pH and low moisture content in soil (Table 1 and 2) may be attributed to industrialization, pollution, inhabitation, and heavy construction in the area. Our study suggests that alkalinity increases the salt content in soil (Table 1)may lead to lower nutrition and mineral absorption by plants rendering the soil conditions difficult in taking up agricultural production. Therefore, drastic measures must be taken to conserve rainwater to reverse the situation.

Table 1: pH values of soil samples taken from different areas

S. No.	Areas of Mumbai	pH
1	Airoli, Ganesh Nagar	8.04±0.08
2	Thane, Kishan Nagar 8	8.48±0.04
3	Mulund, G.V. Scheme	8.5
4	Bhandup	8.4
5	Airoli,Sec. 20	8.0
6	Airoli, Sec. 19	8.5
7	Vikroli	8.3
8	Kalwa	8.5
9	Kurla	8.5
10	Yashodhannagar	8.2

Table 2: Moisture content in the soil samples taken from different areas of Mumbai region

S. No.	Areas of Mumbai	Moisture %
1	Airoli, Ganesh Nagar	80.98
2	Thane, Kishan Nagar	94.39
3	Mulund, G.V. Scheme	95.98
4	Bhandup	78.2
5	Airoli,Sec. 20	88.0
6	Airoli, Sec. 19	98.0
7	Vikroli	75.6
8	Kalwa	98.5
9	Kurla	90.81
10	Yashodhannagar	98.01

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