

Correlation of Different Soil Parameters and Evaluation of Its Effect In A Ramsar Site East Kolkata Wetland

Khaleda Firdous*¹, Swati Chakraborty²

*¹Research scholar, Department of Biotechnology, Gurunanak Institute of Pharmaceutical Science and Technology. 157/ F, Nilgunj Road, Panihati, Kolkata, West Bengal, India

²Corresponding Author, Assistant Professor, Gurunanak Institute of Pharmaceutical Science and Technology. 157/ F, Nilgunj Road, Panihati, Kolkata, West Bengal, India

ABSTRACT

The East Kolkata Wetland is the world's largest natural recycling centre for soluble and solid wastes and spread over 12500 hectares. It is also known as the largest sewage fed aquaculture land in the world and provides 264 sewage-fed fisheries, agriculture and solid waste farms and about 150 metric tons of vegetable everyday from its garbage farms. This study mainly focuses on analysis of different soils of EKW area based on different parameters and evaluates relation between soil properties and macro-nutrients. After analysing the parameters it can be easily said that the soils of this land provides nutrients for the growth of this huge crop production. Also from the Pearson's Correlation analysis it can be concluded that there are some significant positive correlation relationship between the parameters like Organic carbon and Water Holding Capacity, Nitrogen and Phosphorus. A significant negative correlation between Temperature and Water Holding Capacity, Organic Carbon, Nitrogen and Phosphorus has been observed and significant positive relationship between Water Holding Capacity and Nitrogen also exist.

Keywords: Pearson's Correlation, Soil Parameter, East Kolkata Wetland, Physical Parameter

I. INTRODUCTION

The East Calcutta Wetlands, lying at the eastern part of the city (22°27' N 88°27' E), are a complex of natural and human-made wetland. It includes salt marshes and salt meadows, as well as sewage farms and settling ponds (Sanyal et al., 2015). The ground soil of this area provides a huge quantity of crop production regularly. Soil is a naturally occurring porous medium which supports the growth of plants by providing adequate amount of air, heat, water and nutrients. Soil also acts as a reservoir of nutrients required by crops (Patel et al., 2014). Thus for the sake of human health and effective maintenance a continuous monitoring of quality parameters is essential. However it is very difficult to monitor all

the parameters on a regular basis even if adequate laboratory facilities are provided. Therefore as an alternative approach a statistical correlation matrix has been developed to analyze mathematical relationship between the parameters. By doing the analysis we can determine and availability of macro or micro nutrients necessary for the soil fertility as it is one of the biggest reason for crop growth.

II. METHODS AND MATERIAL

A. Study Area:

Soil samples were collected from different zones of East Kolkata wetland. These includes soil from agricultural field i.e the root soil of Brahmi plant, soil

from the sites of different water bodies i.e. Chilparajhil, Mathpukurkhal, Metropolitankhal, 5 No. Jhil and 7 No. Jhil.

B. Preparation of Soil samples for Analysis :

Each of the collected soil samples were homogeneously mixed and left in the air for 2 hours in paper dishes to attain equilibrium. The soil samples were then dried in the oven at 25°C for 2 hours depending upon the wetness. After drying the soil, clods were crushed gently and grounded with the help of a mortar and were passed through 2.0 mm and 0.5 mm stainless steel sieve to remove other impurities like stones, concretions, wood, plant material etc. from the samples. After finishing all the above steps the samples were used for further analysis. (Jackson et al., 1967; Singh et al., 1999).

C. Soil Parameter Tests:

Soil analysis is conducted for one of several possible reasons. In agricultural field mostly the tests are done to estimate the plant-available concentrations of nutrients content, the plant composition, and other characteristics like acidity or pH level. A soil test can also determine fertility, or the expected growth potential of the soil and presence of metals (Black C.A. 1965)

In this work soil parameter tests were divided into two categories: Physical tests and Chemical tests. Physical tests include determination of temperature and Determination of Saturation Moisture Percentage or Water Holding Capacity (Kadam et al., 2005) whereas chemical tests include determination of pH (Davis et al., 1970), measurement of Electrical Conductivity (Singh et al. 1999), determination of Organic Carbon (Page et al. 1982), Nitrogen (Nelson et al., 1972) and Phosphorus (Dewis et al., 1970 & Olsen et al., 1982).

D. Statistical Analysis:

Pearson's Correlation analysis (Bhandari et al., 2008) was done using IBM SPSS statistics 22.

III. RESULTS AND DISCUSSION

A. Temperature: Soil temperature is nothing but the measurement of the warmth in the soil or in other words the measurement of how hot or cold the soil is. Temperature is considered to be a very important physical analysis as it also controls many biological and chemical processes within the soil. The most ideal temperature of soils ranges from 18-24°C because if the temperature gets too high, it kills things that live in the soil, like plant roots and other organisms. Likewise, chemical reactions that aren't mediated by soil organisms tend to go faster as the temperature increases.

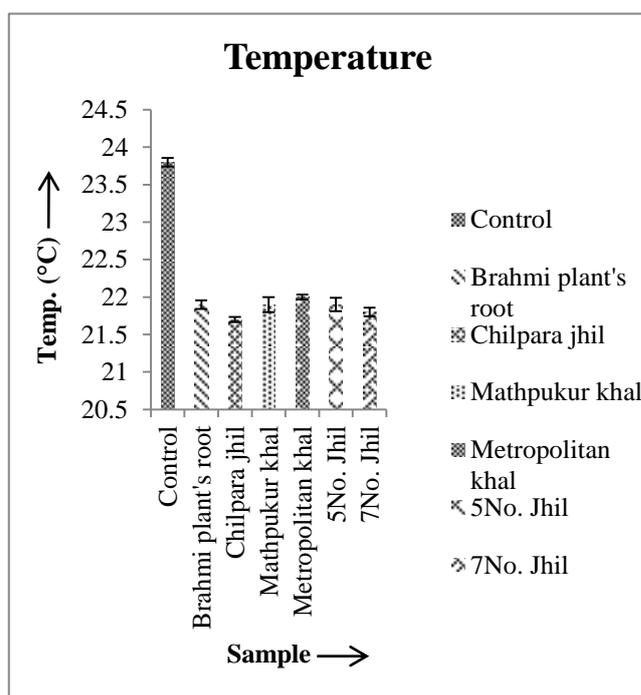


Figure 1: Determination of temperature with standard error

The above graph shows that the temperature of all the samples of the wetlands and the control one is not more than 24°C (Fig:1). So the soil samples are very much ideal for the growth of any kind of plant species

and fully justifies with the huge amount of agricultural field and crop production over there.

B. Determination of Saturation Moisture Percentage/ Water Holding Capacity: This test gives an idea about the capacity of soil to hold water for the use by crops. Decomposed organic matter increases the water holding capacity and also exchangeable sodium and type of clay mineral also have a significant effect on water holding capacity.

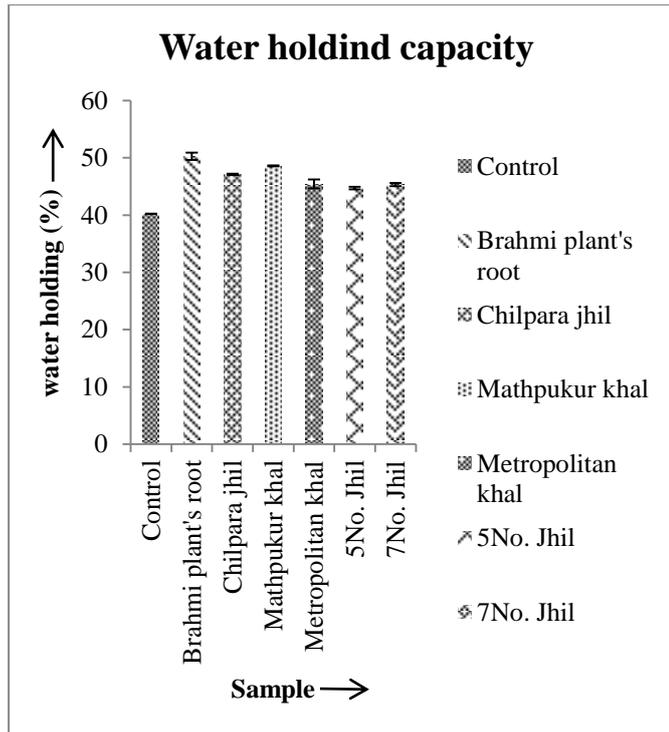


Figure 2: Determination of saturation moisture content with standard error

According to the above result there is a noticeable difference between the control soil and samples. Water holding capacity of sample soils are higher than that of control soil (Fig:2) and this is one of a reason why crop production rate is high in this wetland. As this area also have high amount of organic matter and metals present in the soil compared to control soil it increases the percentage of saturated moister.

C. pH: It has a very important role in determination of the availability of nutrients to plants, plant growth and is also useful for soil classification on the basis of acidity or alkalinity. Generally

extremely acidic soils (pH 4.0-5.0) can have high concentrations of soluble aluminum, iron and manganese which may be toxic to the growth of some plants. The best pH range for most plants is 6 to7 which gives the most ready availability of plant nutrients. Also, some plants grow well only in slightly acid to moderately alkaline (pH 7.4-7.8) soils.

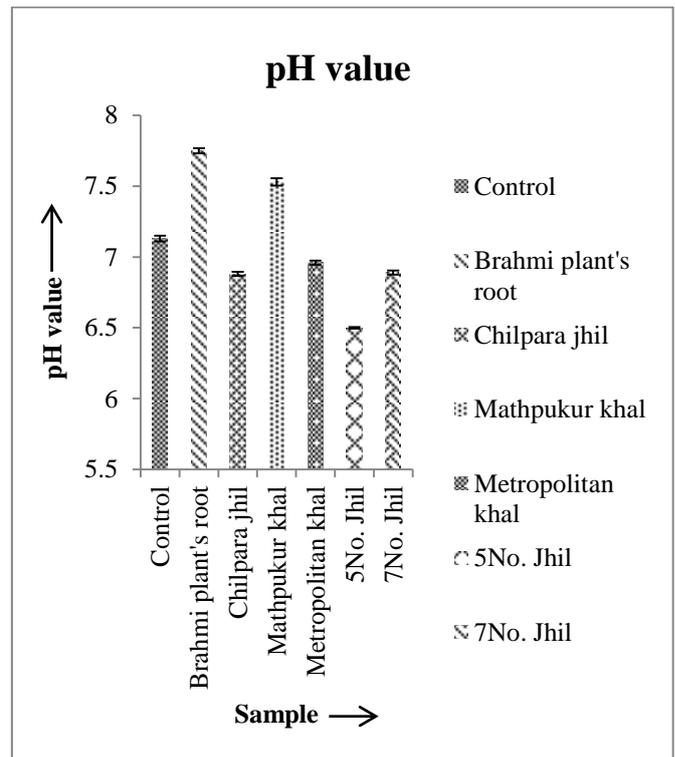


Figure 3: Determination of pH with standard error

Although the wetland is known as one of the largest dumping grounds and contents variety of wastes and heavy metals the pH value is neither very acidic nor very alkaline. The range of pH for the samples in between 6.5 to 8 i.e neutral to moderately alkaline and suitable for plant growth (Fig:3).

D. Measurement of Electrical Conductivity: In soil electrical conductivity gives a measure of soluble salt content of the soil. Pure water is very poor conductor of electric current, whereas water containing the dissolved salts in soil conducts current approximately in proportion to the amount of soluble salts present. Based on this fact, the measurement of electrical conductivity gives a

satisfactory indication of the total concentration of ionized constituents.

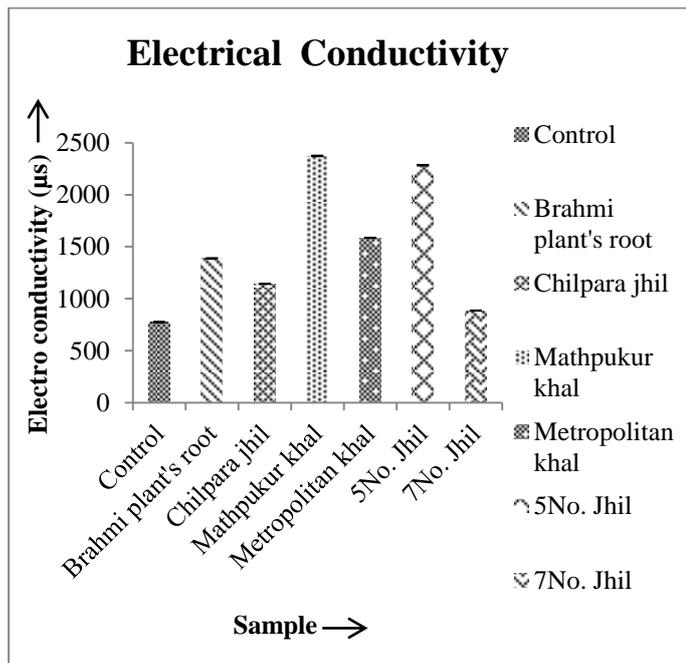


Figure 4: Determination of Electrical conductivity with standard error

The EC values are affected by many environmental factors like climate, local biota, geology as well as human impact and thus these values change depending on the location and condition of the land. It is therefore very much difficult to say the ideal EC levels. However according to general guideline for a good quality soil EC level will be somewhere between 200 $\mu\text{S}/\text{cm}$ and 1200 $\mu\text{S}/\text{cm}$. Though the control soil matches this guideline but each of the soil samples of East Kolkata Wetland having higher amount of wastes and heavy metals fails to match the level by showing EC level starting from more than 1000 μs to 2000 μs (Fig:4).

E. Determination of Organic Carbon: Organic carbon enters the soil through the decomposition of plant and animal residues, root exudates, living and dead microorganisms etc. also it is one of the most important constituent of soil due to its effect on plant growth as both a source of energy and nutrient. It also makes the soil resistant to erosion but porous enough to allow air, water and plant roots to move through soil

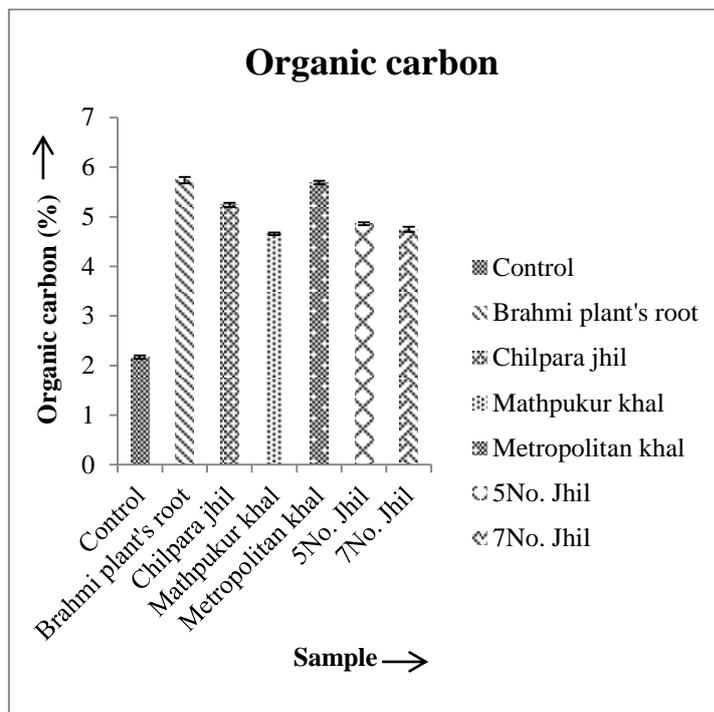


Figure 5: Determination of organic carbon with standard error

The root soil of Brahmi, Metropolitan and chilparajhil area has the highest percentage of Organic Carbon content (Fig:5).

F. Determination of Nitrogen: Nitrogen is present in the soil in organic form and the availability is associated with the activity of micro-organisms. The nitrification rate of a soil is measure of the rate of release of available nitrogen from the organic matter in the soil.

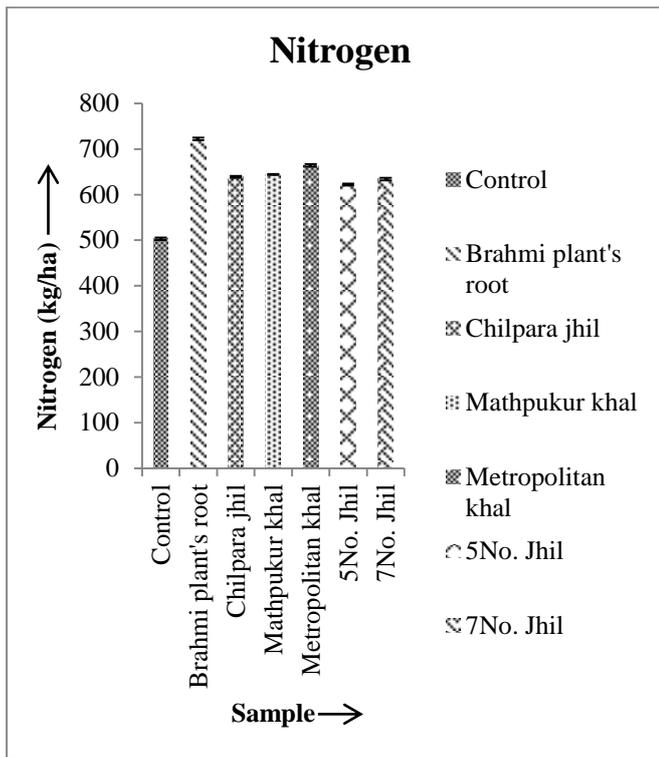


Figure 6:Determination of Nitrogen content with standard error

The soil samples are very rich in Nitrogen content than of the control one. Also among the samples Brahmi root soil consist of the highest amount (Fg:6).

G. Determination of Phosphorous: Phosphorous is also one of the most critical essential element influencing plant growth & production. Phosphorous has an important effect on Photosynthesis, Nitrogen fixation, Crop maturation, Root development, Protein synthesis etc. Thus, it is essential to calculate the available phosphorous present in the soil.

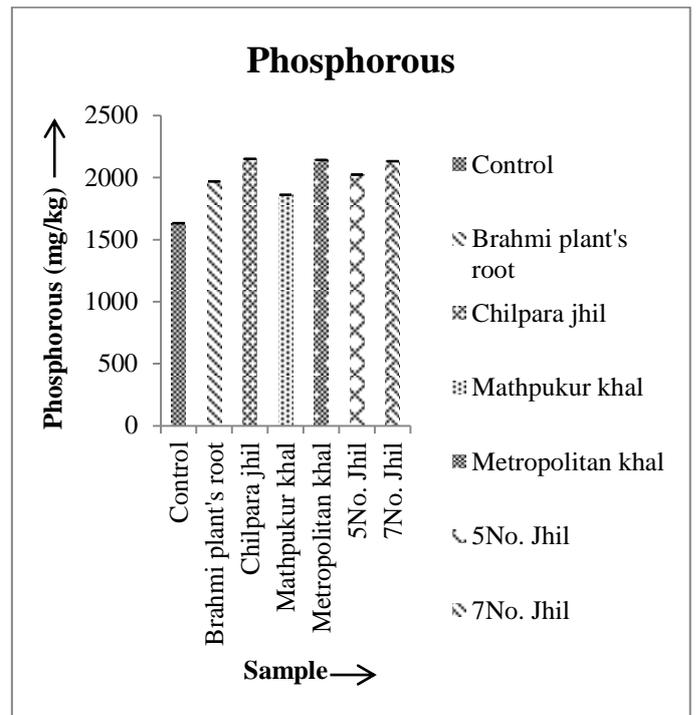


Figure 7:Determination of Phosphorous content with standard error

All the soil samples have a good percentage of phosphorous indicating plant growth and nutrition (Fig:7).

H. Statistical Analysis

The IBM SPSS statistics 22 software was used to get the following correlation matrix of the soil samples. Here pH, Temperature, EC, WHC, Organic Carbon, Nitrogen and Phosphorous was used as variables (Table:1). The following table describes the correlation values between the parameters.

In correlation matrix the P value should be ≤ 0.05 for the test to significant and the test is not significant if the P value is ≥ 0.05 . In the above observed Pearson's correlation there are some values which shows significance with each other. There is a significant positive correlation between the values of Organic carbon and WHC, macro nutrients Nitrogen and Phosphorous i.e. $r(5) = .806$, $P = .029$, $R(5) = .948$, $P = .001$ and $R(5) = .827$, $P = .022$ respectively. Also a significant negative relationship between Temperature and WHC, Organic Carbon, nitrogen and Phosphorous i.e. $r(5) = -$

.783, P=0.037, R(5)= -.911, P = .004, R(5)= -.839, A significant positive relationship between WHC and Nitrogen R (5) = .915, P = .004 was also observed. P=.018 and R(5)= -.843, P=.017 respectively was observed.

Table I: The Pearson's correlation values between different parameters

		Correlations						
		pH	temp	EC	WHC	Nitrogen	OC	Phosphorus
pH	Pearson Correlation	1	.065	.003	.544	.354	.072	-.389
	Sig. (2-tailed)		.889	.995	.207	.436	.879	.389
	N	7	7	7	7	7	7	7
Temp	Pearson Correlation	.065	1	-.435	-.783*	-.839*	-.911**	-.843*
	Sig. (2-tailed)	.889		.330	.037	.018	.004	.017
	N	7	7	7	7	7	7	7
EC	Pearson Correlation	.003	-.435	1	.400	.339	.363	.061
	Sig. (2-tailed)	.995	.330		.374	.457	.424	.896
	N	7	7	7	7	7	7	7
WHC	Pearson Correlation	.544	-.783*	.400	1	.915**	.806*	.438
	Sig. (2-tailed)	.207	.037	.374		.004	.029	.325
	N	7	7	7	7	7	7	7
Nitrogen	Pearson Correlation	.354	-.839*	.339	.915**	1	.948**	.648
	Sig. (2-tailed)	.436	.018	.457	.004		.001	.115
	N	7	7	7	7	7	7	7
OC	Pearson Correlation	.072	-.911**	.363	.806*	.948**	1	.827*
	Sig. (2-tailed)	.879	.004	.424	.029	.001		.022
	N	7	7	7	7	7	7	7
Phosphorus	Pearson Correlation	-.389	-.843*	.061	.438	.648	.827*	1
	Sig. (2-tailed)	.389	.017	.896	.325	.115	.022	
	N	7	7	7	7	7	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

IV. CONCLUSION

All the physical and chemical parameters of the soil samples collected from East Kolkata Wetland have given a satisfactory result indicating a good plant growth and nutrition. However due to the presence of wastes and heavy metals the Electrical Conductivity

value is higher. Also the soil consist a good percentage of macro nutrients like Nitrogen and Phosphorus. The Pearson's correlation shows some significant values between each other indicating the dependence upon each other. An appreciable significant positive correlation have been recorded between the values of Organic carbon and Water Holding Capacity, Nitrogen and Phosphorus. A significant negative

relationship between Temperature and Water Holding Capacity, Organic Carbon, Nitrogen and Phosphorus was found and there is also a significant positive relationship between Water Holding Capacity and Nitrogen. After analyzing all the parameters it can be concluded that the soil of East Kolkata Wetland is mainly influenced by the Temperature and Water Holding Capacity and all the other factors are having a significant dependence on them influencing the soil quality and plant growth.

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