

Studies on some chemical characteristics of Agricultural soil around Sugar industry near Purna, Maharashtra

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Abstract

The soil quality indicator via physico-chemical analysis shows its status of healthiness as well as pollution occurrence. Soil is a mixture of organic and inorganic matter also minerals, dead and living organisms (organic materials), air and water etc. These all ingredients react with one another in amazing ways and making soil one of our planet's most dynamic and important natural resources. The study of soil was undertaken as to find out the impact of sugar factory effluents in a surrounding environment of near Purna city.

The soil samples were collected in polyethylene bags with all precautions from different locations of the sugar industry areas at Purna city, this area is having good agriculture practices. The study was carried out during year 2019. Initially we planned to analyse the chemical parameters of soil like pH, Soil chlorides, Soil hardness and Soil organic matter was determined in the laboratory. The obtained results were compared with standard prescribed limits of WHO and ISI (10500-91). It was noted that the soil samples were collected from different location of near Purna city were within the permissible limit.

Key words : Soil quality, Industrial effluents, Pollution status.

Soil, it is not wrong to assume that for humans and other living beings, hence soil is the basis for all terrestrial lives including humans. Although it provides a lot of nutrients, it has a unique place and plays an important role in our world. It is the centrepiece of all life. The biotic cycle depends upon the soil and its physico-chemical process. We rely on the

soil for various purpose like irrigation, water filtration and nutrition for humans and biological life forms.

The principal source of soil is parental material *i.e.*, rock. Any change in physico-chemical and biological characteristics of soil leads to great disturbance in the biotic cycle

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as well as interrupt the equilibrium of the nature. It directly impacts on the food chain and the process of energy transfer from tropic level to other one. The Soil have complex and delicate ecosystem, as they cannot have cleaned itself, therefore pollutants accumulate and biomagnified. In the present study Purna city is selected for investigation of soil samples near to sugar industry of Parbhani district.

Soil nutrients :

Many more elements or nutrients are essential for plant growth and reproduction and to continue its life cycle. They are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, iron, manganese, copper, zinc, molybdenum, and chlorine. Soil is one of the most vital resources of the nature¹⁴. Nutrients required for plants to complete their life cycle are considered essential nutrients. Nutrients that enhance the growth of plants but are not necessary to complete the plant's life cycle are considered non-essential. The soil organic matter and carbon is vital, it contributes to soil health and its fertility. It releases several nutrients for plant growth, enhancing soil organic carbon improves soil quality³.

Except for carbon, hydrogen, and oxygen, which are supplied by carbon dioxide and water, the nutrients derive originally from the mineral component of the soil. Most of the crucial elements are found in liberal quantities in the nutritional soils⁶. Although minerals are the origin of those nutrients, the organic component of the soil is the reservoir of most readily available plant nutrients. For the nutrients to be available to plants, they must

be in the proper ionic form (except for water and CO).

Sugar factory :

India is agriculture-based country and there is an excessive demand of water for irrigation while large quantity of effluent is discharged into water source as untreated. Use of industrial effluent for agricultural have become common practice in India, because of which these toxic metals get accumulated into plant tissue from the polluted soil. The sugar industry is playing a vital role in the overall development of the specially in India, but the effluents released produce a high degree of organic waste in both aquatic and terrestrial ecosystems¹. The sugar industry plays a crucial role in the financial development of the region, but on the other hand untreated wastes produce a high amount of organic pollution in both earthy and aquatic system. Disposal of industrial waste has created dual problem that has degraded the soil fertility and contaminated the food-chain.

Sugar mills play a major role in polluting the water bodies and land by discharging a huge amount of wastewater as effluent⁷. Several chemicals are used during the sugar manufacturing process mainly for coagulation of impurities and refining of the end products. Large number of effluents generated during the manufacture of sugar contains a high amount of pollution load particularly Suspended solids, Organic matters, Press-mud, Bagasse and Air pollution. Discharge of sugar industry effluent to the land of irrigation influences the physico-chemical characteristics of soil. The waste of factories

penetrates in the soil and reach by percolation to ground water. These effluents produce drastic impact on ground water quality via changing its chemical structure. The status of soil has a significant impact on the distribution and growth of vegetation⁴.

The sugar mill effluents can be a source of contamination to the soil as some toxic metals may also be transfer to roots and then to leaves. Likewise, an impact of sugar factory waste on some chemical characteristics of soil was carried out. Similarly, another report showed the impact of irrigation via sugar factory waste *i.e.*, spent wash and the water from nearby area of sugar factory in Wardha district of Maharashtra. The polluted soil by sugar industry becomes unsuitable for further cultivation of crops. Presently, India has more than 650 sugar mills, that produce about 115 million tons of sugar and 13 million tons of molasses. Soil and water are the most crucial natural characteristics in Agrarian field¹¹.

These mills discharge huge amount of effluent per day without any treatment or partial treatment during the crushing season. It has

also been reported that sugar mills effluent contains a high magnitude of pollution load and causes antagonistic effects on soil⁹. The continuous use of these effluents harmfully affects the crops when used for irrigation. As a result, a higher number of various elements get deposited in the soil and make them polluted. However, some time effluents containing various metallic and non-metallic elements which act as nutrients, but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield in cultivated land.

Study area :

Purna is a town with a municipal council in Parbhani district in the Indian state of Maharashtra. Purna is located at 19.18°N 77.05°E. Purna has an average elevation of 386 metres (1266 feet). Purna is one taluka out of eight from Parbhani district of Marathwada region of Maharashtra. The sugar industry is situated near Purna city, this area also having good agricultural land and good crops etc.



Fig. 1: Google Image showing the Soil Sampling Sites near Sugar factory at Purna City.



Fig. 2: Collection of Soil sample form site.



Fig. 3: Soil sampling at another site.



Fig. 4: A general view of present research site of Sugar factory near Purna city.

In the nearby Purna city the Sahakari Sakhar Karkhana (sugar industry) is an important milestone specially in Agro-industries. Purna Sugar Factory is like a KALPAVRUKSHA for the people of this area around which he has visualised, now of different economic opportunities. Authorities of this industries had identified several interconnected plans and programmes which

include production of spirit and other chemicals, co-generation of electricity plant, agricultural information services for famers. This industry has their own waste treatment plant, which is working in as per the information provided them. Hence, in our continuous soil analytical study and observations, we do not note any pollution sources specially of soil, nearby farmland.



Fig. 5: Soil sample collection view.



Fig. 6: On site soil sample packing.

Present study conducted to identify the possible impact of sugar factory on the soil quality by analysis of various chemical parameters of soil. The soil samples were selected from different sites of this sugar factory and collected in polyethylene bags from two sites. Effluents from sugar factory are less and not found in concentrated state. We also observed few nala nearby this factory but not seen any drastic change due to its pollutant discharge. They treat this waste generated from factory and managing quite well. No severe pollution was found nearby the factory. Our aim is to find out the effect of sugar factory pollutant on soil quality. All these soil samples brought in the laboratory and according to standard procedure carried out its analysis. Soil samples were taken once in a month for a period of twelve months (year 2019).

Chloride is rarely thought of as an essential nutrient. But it is in cultural agronomy, chlorides are said to be a much more intense salt. It is important in the role of fertility of soil if the concentration increases it burn the plants.

The present study reveals the level of chloride in soil minimum ranged 14 mg/kg at one site in the month of November 2019 and maximum ranged 126 mg/kg at both sites during January and May respectively. The Google image of the study area is shown in fig. 1. Collection of soil samples is depicted in fig. 2 & 3, 5 & 6. Sugar factory side is shown in fig. 4. Various chemical parameters of the soil samples are shown in figs. 7-10. Various chemical contents of the soil sample are given in table-1.

The pH of the soil samples was recorded in laboratory with the help of digital pH meter. Soil organic matter is analysed by Walkley-Black-chromic acid wet oxidation method. The soil chlorides were estimated by titrimetric method, all the soil samples were made soluble in the laboratory with the help of distilled water and the results are expressed in mg/L. the hardness of soil samples were carried out with using EDTA method, which widely used in the testing laboratory, these results are also noted in mg/L and compared with standard soil parameters.

Table-1. Values of Chemical parameters observed (mg/L) of Soil near Sugar Industry during 2019.

Month & Year	pH	Chloride (mg/L)	Soil Hardness (mg/L)	Soil Organic Matter (mg/L)
Jan, 2019	7.4	126	258	0.28
Feb, 2019	7.2	124	262	0.24
Mar, 2019	7.4	120	254	0.26
Apr, 2019	7.2	118	252	0.24
May, 2019	7.2	116	250	0.22
Jun, 2019	7.3	124	246	0.2
Jul, 2019	7.4	122	248	0.22
Aug, 2019	7.3	122	244	0.24
Sept, 2019	7.4	122	244	0.24
Oct, 2019	7.3	116	242	0.26
Nov, 2019	7.3	114	240	0.24
Dec, 2019	7.1	118	244	0.22

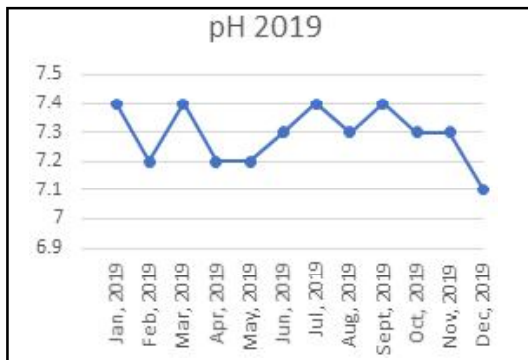


Fig. 7: Soil pH noted during the study.

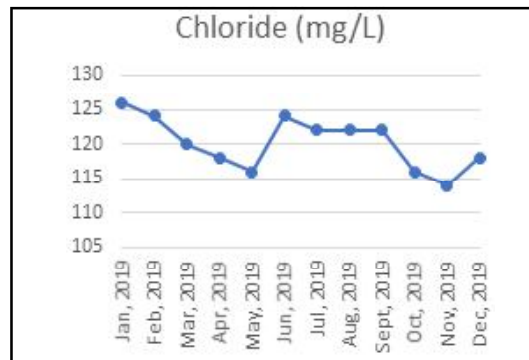


Fig 8: Mean values of soil Chlorides recorded.

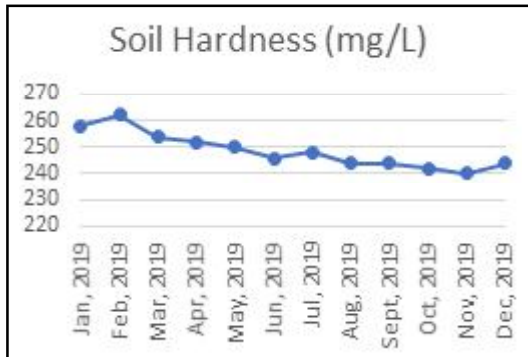


Fig. 9: Soil hardness mean values noted.

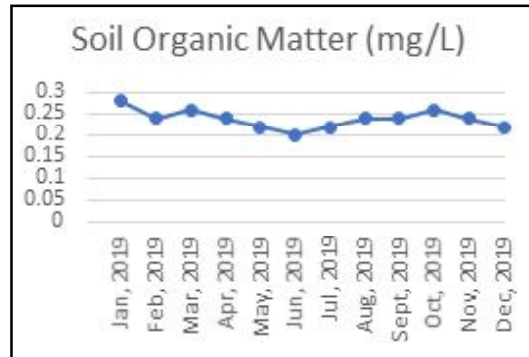


Fig. 10: Values of Soil organic matter content.

pH of the soil samples and the sediments is indicating the soil acidity or alkalinity and it is one the stable measurement. The minimum pH value was found during the month of January to December 2019 from different sites and were ranged as 7.1 and the maximum values ranged as 7.4 respectively.

Soil hardness is the indicator of soil compaction status, the present investigations indicated the soil hardness of Purna city. Minimum values ranged as 240 mg/kg at a site in the month of November and maximum ranged 262 mg/kg in February of 2019.

Soil organic matter is a crucial source of plants as well playing an important role in macro and micronutrients. It is one the major source of food for microbes living in the soil. The amount of soil organic matter was found minimum in both sites and ranged as 0.2 mg/kg and maximum ranged as 0.26 at one site in the month of January 2019.

Seema *et.al.*,¹² studied the effect of Soil Physical Chemical Properties of Selected areas in South Western Region of Rajasthan. They noted the minimal pH value as 7.01 in Balita Agriculture field and maximum 8.02 found in Thermal Bundi Road and DCM Road, whereas lowest chloride 0.28 mg/L and maximum ranged 0.82 mg/L respectively.

Marshal⁵, studied Physical Chemical Properties of Soil from Abohar City during 2017. The five soil samples were collected in the depth of 0 to 20cm. The minimal pH ranged 7.98 at sampling site 2 and 4 and maximum was found 8.42 at sampling site 5. On the other hand, the chloride ranged minimal 1.23mg/L at sampling site 2 and maximum was 1.98mg/

L at sampling site 5 respectively.

Pramod and Amruta¹⁰, investigated the physical chemical parameters of soil samples from Dandi, Gujrat during 2021. They selected pH and organic matter for their study. They took seven samples for their research sites. They found lowest pH at 8.26 at sampling site 1 and 5 and highest 8.67 at sampling site 6. The organic matter minimal ranged 0.64 mg/L and maximum was 0.7mg/L respectively.

Devi and Muthuchelian², studied the pH and organic matter from paddy field soil samples at Theni district of Tamilnadu. They analysed and found the minimal pH was recorded 7.4 at Upparpatti and maximum ranged as 7.9 at Uthamapalayam. Whereas, the organic matter lowest noted 0.71mg/L at Upparpatti and highest 0.93 mg/L.

Oyeyiola and Agbaje⁸, analysed the pH and organic matter of Soil near Microbiology Laboratory of the University of main campus, Ilorin. The soil samples were taken via two-week interval on six different times. In this study the lower pH was noted 7.10 at sampling period (Week) 1 and maximum was 7.82 at 9. Whereas, the organic matter observed 3.42 mg/L minimal and maximum was 4.70 mg/L respectively.

Sangita¹¹, studied on organic carbon of Sangamner city Ahmednagar during 2018. She found the lowest organic carbon 0.52 mg/L at sampling site 5 and maximum was 0.7 mg/L at sampling site 3 respectively.

The present study was undertaken for analysis of different chemical parameter studies of this soil, if affected any by sugar

factory effluents. Study carried out from selected chemical parameters during entire year, which are indicated in the table, graphs, and figures. The pH as well as Soil hardness, Soil organic matter and Soil chlorides are not affected by any means of sugar factory effluents, it is a good sign of treatment of this industry waste in the unit itself. The present undertaken analytical work and values obtained will be significant for further research studies. In this research work we found the agricultural soil were not affected by means of any pollutants from this sugar factory.

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