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STUDY OF PHYSICO-CHEMICAL PROPERTIES OF INDUSTRIAL ZONE SOIL FROM LOTE M.I.D.C, MAHARASHTRA, INDIA

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Abstract

The article presents an overview of impact of factory waste on soil nutrient quality. 15 soil samples were collected from mango orchard at Lote MIDC area tahsil Khed, District Ratnagiri, Maharashtra (India) during pre and post-monsoon season. The physico-chemical parameter *viz*., pH, EC, organic carbon, available nitrogen, phosphorus, potassium, sulphur, exchangeable calcium and magnesium are 4.45, 0.067 dSm^{-1}, 1.94 per cent, 365.82, 6.87, 168.37 ($kgha^{-1}$), 7.82 $mgkg^{-1}$, 3.98 and 0.82 (meq 100^{-1}), respectively in pre-monsoon season. In post-monsoon, the pH, EC, organic carbon, available nitrogen, phosphorus, potassium, sulphur, exchangeable calcium and magnesium are 4.50, 0.072 dSm^{-1}, 2.37 per cent, 301.89, 5.78, 130.58 ($kgha^{-1}$), 10.20 $mgkg^{-1}$, 2.91 and 0.65 (meq 100^{-1}), respectively. The results revealed that soil nutrients are decreased in post-monsoon. The organic carbon increased in post-monsoon as pre-monsoon season.

Key words : MIDC, factory waste, high rainfall, industrial waste.

Introduction

Soil is one of the vital resources on living planet Earth. In recent year, considerable attention has been paid to industrial waste, which is usually discharge on land or into the source of water. Inherent soil physico-chemical properties influence the behavior of soil and hence, knowledge of soil property is important (Rajbala *et al*., 2012). Soil is an important system of terrestrial ecosystem, and direct discharge of industrial effluents especially that without treatment may have deeply influence on physico-chemical and biological properties of soil related to soil fertility (Kumar *et al*., 2012). The waste material discharges from industrial activities causes adverse effects on soil. The presence of heavy metals and residues from town and industrial wastes has been found to be the causes of pollution in soil.

The industries produce lot of chemical waste in solid and liquid form, which are disposed on adjacent land. The liquid wastes are disposed through CETP (Common Effluents Treatment Plants) or flowed by small canal and finally in river. These chemicals wastes contain heavy metals and some harmful substances and those wastes can modified the physical, chemical and biological properties of soil. The physico-chemical analysis of soil reveals the impact of industrial waste on soil health. This evaluation can also important for purpose of soil physical health and soil pollution. However, the long term studies about contamination of soil need to be examined.

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Materials and Methods

The study area includes parts of Lote M.I.D.C. in Ratnagiri district. The Ratnagiri district is geographically situated in latitude of 16.58^0 to 16.98^0 N and 73.180^0 to 73.30^0 E longitudes. Lote M.I.D.C. is situated 45 Km away from College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli (Maharashtra), India; on Mumbai-Goa National Highway. In that area, soil is generally lateritic soil. The region receives very high rainfall (above 3000 mm annually). Month of May is generally the hottest, with a mean maximum temperature of around 33^0C. During rainy season, humidity is as high as 90 to 98 per cent. It is least in winter afternoon, when it may come down to about 60 per cent.

Soil samples were collected from nearby side MIDC (Maharashtra Industrial Development Corporation) of Lote dist. Ratnagiri. In those areas lot of factory are produced fertilizer, agro-chemical, acid dyes, paints, machine tools materials and resins etc.

Fifteen surface soil samples were collected at twice time viz., before the monsoon, in the month of June and after monsoon, in the month of October from mango orchard. The soil is put in thick polythene bags and immediately brought to laboratory. All the surface soil samples were air dried under shed in an open room. Then the impurities like stones, pebbles, roots, dried leaves etc. were removed and the soil samples were ground in wooden mortar and pestle and sieved through 2 mm and 0.5 mm sieve for special determination like soil organic carbon (Tandon, 2010 and Pal, 2013).

Results and Discussion

pH

The physic-chemical analysis of soil is given in tables 1 and 2.

The pH range of all soil samples in industrial area from 4.15 to 5.14 with an average value of 4.45 and 3.89 to 6.03 with a mean value of 4.50 in pre-monsoon season and post-monsoon season, respectively. In general, lateritic soils are acidic in nature. The acidic nature of soil might be attributed to the leaching of soluble salts due to heavy precipitation in rainy season. In post-monsoon season, the soil pH is increased as compared pre-monsoon season due to addition of rain water (Solanki *et al*., 2012).

Electrical conductivity

Electrical conductivity is a measure the ions present in water. The electrical conductivity of soil in pre-monsoon varied from 0.051 to 0.094 dSm^{-1} with an average value of 0.067 dSm^{-1}, while for post-monsoon season it showed variation from 0.047 to 0.114 dSm^{-1} with a mean value of 0.072 dSm^{-1}. The electrical conductivity increased in post-monsoon season as compared to pre-monsoon season. In laterite soil, when the water content increases electrical conductivity also increased (Kong *et al*., 2013).

Organic carbon

The organic carbon in soil on pre and post- monsoon season ranged from 0.95 to 2.63 per cent with a mean value 1.94 per cent and 1.77 to 3.10 per cent with an average value 2.37 per cent, respectively indicating that the soils are 'very high' in organic carbon content. In general, the organic carbon content in the lateritic soils of Konkan is in 'very high' range as per the ratings proposed by Bangar and Zende (1978). The very high organic carbon content of the soil might be attributed to the hot and humid climate of the Konkan region. In general, wetland soil has more organic carbon content than terrestrial soil because presences of soil microorganism are responsible for decomposition of organic matter (Ingavale *et al*., 2012).

Available nitrogen

The available nitrogen in soil for pre-monsoon season ranged from 235.20 to 454.72 kg ha^{-1} with a mean value of 365.82 kg ha^{-1}, while an average value of 301.89 kg ha^{-1} during post-monsoon season and it ranged between 235.20 to 392.28 kg ha^{-1}. These soils are 'Low' to 'Moderate high' in available nitrogen content as per the standard ratings. In pre-monsoon season, the available nitrogen content is higher than post-monsoon season due to mineralization of organic carbon that have released large amount of nitrogen in soil (Prasad *et al*., 2008).

Available phosphorus

The available phosphorus in soil at various samples ranged from 3.55 to 13.51 kg ha^{-1} with a mean value of 6.87 kg ha^{-1} and 3.12 to 8.97 kg ha^{-1} with an average value of 5.78 kg ha^{-1} in pre and post-monsoon seasons, respectively indicating that these soils are 'low' in available phosphorous content. In general, the available phosphorous content in the lateritic soils of Konkan is in 'low' range. This is due to high phosphorus fixation capacity. The available phosphorous in lateritic soils of Konkan region varied from 0.35 to 74.14 kg ha^{-1} with an average value of 14.14 kg ha^{-1} (Chavan, 1979; Dabke, 1987 and Dongale, 1987).

Available potassium

Potassium is the essential component for all plant growth and found in all type soil. Elemental potassium does not occur in nature due to rapid reaction with water. The available potassium in soil during pre-monsoon season varied from 114.24 to 302.20 kg ha^{-1} with a mean value of 168.37 kg ha^{-1}, while for post-monsoon season it was 92.96 to 230.72 kg ha^{-1} with an average value of 130.58 kg ha^{-1}.

In post-monsoon season, the potassium content decreased in soil as compared to pre-monsoon season. In rainy season the potassium present in soil is easily dissolved in water and eroded off. It clearly indicates that the solubility of potassium in rainy season is higher than in dry season (Srikantaswamy, 2012).

Exchangeable calcium

Calcium is present adequate amount in soil. Calcium is a component of several primary and secondary mineral in the soil which is soluble for agricultural consideration. In present study, the exchangeable calcium in soil during

Table 1 : Physico-chemical characteristics of industrial zone soil on pre-monsoon.

Sample no.	pH	EC (dSm^{-1})	OC (per cent)	N ($kgha^{-1}$)	P ($kgha^{-1}$)	K ($kgha^{-1}$)	Ca ($meq\ 100^{-1}$)	Mg ($meq\ 100^{-1}$)	S ($mg\ kg^{-1}$)
1	4.20	0.074	2.33	329.28	4.98	125.44	1.70	0.40	2.42
2	4.15	0.055	2.25	424.24	6.16	114.24	1.60	0.60	8.75
3	4.56	0.068	0.95	392.00	3.55	138.88	3.20	0.60	6.06
4	4.31	0.054	1.12	423.36	6.40	132.16	3.00	1.00	3.63
5	4.47	0.051	2.63	407.68	13.51	169.12	4.60	0.20	6.66
6	4.66	0.073	2.25	390.28	8.77	132.16	3.50	1.00	11.51
7	4.46	0.057	2.19	344.96	6.63	141.12	2.10	0.40	5.45
8	4.33	0.094	2.07	235.20	5.92	118.72	2.80	0.30	7.87
9	4.37	0.075	1.30	321.5	7.35	189.28	3.10	0.30	7.87
10	4.31	0.074	2.54	344.96	6.40	129.92	2.80	0.00	5.45
11	4.45	0.056	2.27	360.64	4.98	302.40	8.10	1.50	9.21
12	4.63	0.052	1.15	313.60	4.50	244.16	7.80	2.10	9.69
13	4.27	0.085	2.54	454.72	6.16	202.72	4.30	1.70	11.51
14	5.14	0.066	1.09	352.70	5.45	237.44	5.70	1.30	13.21
15	4.43	0.077	2.42	392.28	12.32	147.84	5.40	0.90	7.27
Mean	**4.45**	**0.067**	**1.94**	**365.82**	**6.87**	**168.37**	**3.98**	**0.82**	**7.82**

Table 2 : Physico-chemical characteristics of industrial zone soil on post-monsoon.

Sample no.	pH	EC (dSm^{-1})	OC (per cent)	N ($kgha^{-1}$)	P ($kgha^{-1}$)	K ($kgha^{-1}$)	Ca ($meq\ 100^{-1}$)	Mg ($meq\ 100^{-1}$)	S ($mg\ kg^{-1}$)
1	3.90	0.100	3.07	282.24	4.03	112.00	2.30	0.40	4.84
2	4.23	0.047	2.84	392.28	5.21	96.86	1.40	0.20	12.39
3	4.40	0.062	2.21	282.24	6.87	108.64	1.90	0.00	18.17
4	4.25	0.055	3.10	250.88	7.11	92.96	2.10	0.80	1.21
5	4.35	0.058	2.99	376.32	5.92	113.12	1.50	0.40	12.72
6	4.24	0.103	1.77	313.60	4.98	100.80	1.40	0.50	15.14
7	4.15	0.051	1.98	326.45	4.50	97.44	2.00	0.30	12.11
8	4.42	0.053	1.98	297.28	3.79	109.80	3.10	0.60	8.48
9	4.03	0.046	1.77	282.24	5.21	137.76	2.30	0.30	4.84
10	3.84	0.069	2.39	297.92	7.11	112.80	2.00	0.70	2.42
11	5.34	0.061	2.07	360.64	3.45	230.72	7.30	0.90	6.66
12	4.78	0.092	2.57	297.92	3.12	120.96	5.40	1.80	7.27
13	4.67	0.104	2.72	282.24	4.87	118.28	3.10	1.30	16.35
14	6.03	0.114	2.13	250.88	4.03	218.40	3.60	0.90	16.58
15	4.86	0.067	1.89	235.20	8.97	188.16	4.20	0.60	15.14
Mean	**4.50**	**0.072**	**2.37**	**301.89**	**5.78**	**130.58**	**2.91**	**0.65**	**10.29**

pre and post-monsoon season ranged from 1.60 to 8.10 meq 100^{-1} g with a mean value of 3.98 meq 100^{-1} g and 1.40 to 5.40 meq 100^{-1} g with an average value of 2.91 meq 100^{-1} g, respectively. The calcium content is decreased in post-monsoon season due to leaching losses of calcium with heavy rainfall.

Exchangeable magnesium

Magnesium is an alkaline earth metal and seventh most abundant in earth crust, where it constitutes about 2 per cent. Due to magnesium ions is high solubility in water it is third most abundant element dissolved in seawater.

In the present study area, pre-monsoon season, the exchangeable magnesium ranged between 0.00 to 2.10

meq 100^{-1} g with a mean value of 0.82 meq 100^{-1} g, while in post-monsoon season, it varied from 0.00 to 1.80 meq 100^{-1} g with an average value of 0.65 meq 100^{-1} g. In post-monsoon season, the magnesium content in soil decreased as compared to pre-monsoon season due to leaching through heavy rainfall (Kumar *et al*., 2012). Srikantaswamy *et al*. (2012) also found the similar results in industrial area of Mysore city, Karnataka.

Available sulphur

In present study area, the available sulphur in soil during pre-monsoon season varied from 2.42 to 13.21 mg kg^{-1} with a mean value of 7.82 mg kg^{-1}, while in post-monsoon season 10.20 mg kg^{-1} was an average value of sulphur and it ranged between 1.21 to 18.17 mg kg^{-1}. Ghosh *et al*. (2012) also observed the available sulphur varied from 16.2 to 35.0 mg kg^{-1} with a mean value of 29.5 mg kg^{-1} in laterite soil of West Bengal, India. In post-monsoon season, the sulphur content was higher in soil as the rainfall might have added a significant amount of atmospheric sulphur in soil (Jones *et al*., 1982 and Blair *et al*., 2005), but the amount deposited varies from one place to another, being higher near the industrial areas (Wang *et al*., 2005).

Conclusion

An assessment of soil health is important in general industrial region because they produced soil pollution. The industrial waste created long term effect on soil health and further effect on their crop productivity. The different samples of soil in industrial area showed difference in the physico-chemical characteristic from one season to another season. In the present study, the post-monsoon was higher value than pre-monsoon season.

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