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Assessment of molybdenum status in soil of Sindhudurg district of Maharashtra

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Abstract

The present investigation was undertaken to the assessment of molybdenum status in soil of Sindhudurg district, The Eighty surface soil samples (0-20 cm) were collected from the field of major crop in Sindhudurg district of Maharashtra. Ten soil samples from each tehsil from Kudal, Sawantwadi, Kankavli, Devgad, Malwan, Vengurla, Dodamarg and Vaibhavwadi from Sindhudurg district were collected and analysed during the 2018-2019. The results indicated that, the physico-chemical properties of soils of Sindhudurg district found to be acidic to neutral in reaction. The electrical conductivity ranged between 0.04 to 0.55 dS m⁻¹ showing non saline nature of soil. The calcium carbonate was found in the range of 1.12 to 5.36 per cent. The organic carbon was found medium to high varied from 2.24 to 16.49g kg⁻¹. The available nitrogen was observed low to medium varied from 134.70 to 417.26 kg ha⁻¹ indicates. The available phosphorus varied from 3.08 to 14.25 kg ha⁻¹ indicates low available phosphorus status. The available potassium was recorded medium to high status. The nutrient index of available nitrogen was recorded in range from 1.30 to 1.60, available P 1.0 to 1.10 and available K, 2.70 to 3.00. Available molybdenum was recorded ranges from 0.01 to 0.62 mg kg⁻¹ the soils of Sindhudurg district. The nutrient index of available molybdenum was recorded 1.82. However the 38.35 per cent soil samples were found deficient in available molybdenum.

Keywords: Organic carbon, molybdenum, correlation. GPS

Introduction

Soil, in traditional meaning is the natural medium for the growth of plants. Soils are all unconsolidated material of the earth's crust in which plant grow, which are used as both food for humans and animals. Micronutrients are the nutrients which required in small quantities are known as micronutrients or trace elements. These are very efficient and minute quantities produce optimum effect on other hand, even a slight deficiency or excess is harmful to the plants. Though micronutrients are required in traces but they are just as important as the major element.

Molybdenum (Mo) was identified as an essential element for higher plant in 1939. (Arnon and Stout, 1939) [3]. Most of the crops required less than 1 part per million (ppm) of this element. Soils contain about 0.25-5.0 ppm total molybdenum. It is found in trace amount in the mineral olivine, in some iron and aluminium oxides and hydroxides, and in clay silicates (Schulte 2004) [18].

Molybdenum plays a crucial role in nitrogen metabolism in plants Because of its involvement in the nitrate assimilation, nitrogen fixation process, and transport of nitrogen compound in plants. (Li *et. al.* 2013) [11]. Availability of Mo to plants is influence by soil parameters like pH, organic matter and clay content (Behera *et.al.* 2011) [4]. Molybdenum is required for growth of most biological organism including plants. Some soil types are more vulnerable to molybdenum deficiency than other. A deficiency is much more likely in soils with pH less than 5.8 (Yoshitaka, 2013) [23].

Application of lime increases soil pH resulting in an increase in negative charges on soil particles and a decrease in the activities of iron and aluminium oxides which are good sink for Mo in soils. Thus may enhance Mo availability in soils and to crops (Anonymous, 1979; Riely *et. al.* 1987) [2, 16]. Information regarding the availability of molybdenum Indian soil is quite meagre, very sporadic and non-systematic due to cumbersome time consuming method of its analysis in soil and plants. Therefore, considering all these facts the present study was undertaken to improve the fertility and productivity of Sindhudurg district. merit. Similarly length at 95 DAS, number of nodes at 95 DAS, number of branches at 45 DAS were the good general combiners.

Material and method

Sindhudurg district is southernmost part of konkan low land of Maharashtra state covering an area of 5207 sq.km. The climate of Sindhudurg district is generally humid and the district falls under "Assured and high rainfall zone". The average annual rainfall in the district is 3247 mm and the maximum humidity in the district is 88.6 per cent.

The main types of the soil found in the district are salty soil, coastal alluvium and lateritic soils. It varies in colour from bright red to brownish red owing to the preponderance of hydrated iron oxide. The heavy rains in the region thoroughly leach the soil turning them to acidic in reaction and fairly well supplied with nitrogen and organic matter. Eighty soil samples (0-20 cm) representing different soils were collected from eight tehsils of Sindhudurg district viz., Kudal, Sawantwadi, Kankavli, Devgad, Malwan, Vengurla, Dodamarg and Vaibhavwadi. The latitude, longitude and altitude of sampling sites in the study area were recorded with the help of Global Positioning System. The soil samples were processed, air dried and sieved through 2 mm sieve for different parameters. The soils samples were analysed for important physico-chemical properties following the standard laboratory procedure.

The pH and EC of soil was determined using 1:2.5 soil: water suspension ratio (Jackson,1973)^[9], The Soil organic carbon was determined by Walkley and Black wet oxidation method (Jackson,1973)^[9], Calcium carbonate estimated by rapid titration method (Piper,1966)^[13], available nitrogen was determined by alkaline permanganate method (Subbiah and Asija, 1956)^[20], available phosphorus was determined by NH₄-HCL method when the pH below 6.5 (Bray and Kurtz,1945)^[6], and pH above 6.5 it was extracted using the Olsen's extractant (0.5 M NaHCO₃ of pH 8.5) as described by Watanabe and Olsen (1965)^[22], available potassium was determined by flame photometer using neutral normal ammonium acetate (pH 7.0) as describe by Knudsen and Peterson (1982)^[10] and available molybdenum was determined by grigg's reagent method (Grigg,1953)^[8]. The data were statistically analysed by using the standard procedure given by Panse and Sukhatme (1985)^[12].

Results

Physico-chemical properties of soil

The pH of soil varied from 4.27 to 6.91 with a mean value of 5.63 (Table 1). Ninety percent of soil samples were found in acidic nature. This might be due to the washing of bases due to heavy precipitation and simultaneous accumulation of iron and aluminium oxides resulting in decrease of silica sesquioxides ratio. The pH of lateritic soils of Konkan ranged from 5.35 to 5.97 with mean value of 5.70 reported by Shinde *et. al.* (2010)^[19].

The EC of the soil ranges from 0.04 to 0.55 dS m⁻¹ with mean of 0.20 dS m⁻¹ which indicated the low electrical conductivity of the soil. The lowering electrical conductivity might be due to heavy precipitation resulting into leaching of soluble salts in soil. Similar finding was reported by Wagh and Sayyed (2013)^[21] observed that EC of Panvel area ranges from 0.13 to 0.27 dS m⁻¹.

The calcium carbonate content ranged from 1.12-5.36 per cent with mean value of 2.45 per cent for the district (Fig 1). This might be due to leaching of bases like calcium from soil which indicate non- accumulation of CaCO₃ in surface soil.

Rajeshwar and Khan (2007)^[14] reported that, the calcium carbonate ranging from 0 to 2 per cent, due to leaching of exchangeable Ca⁺⁺.

Organic carbon content of soils in Sindhudurg district is varied from 2.24 to 15.85g kg⁻¹ with mean value of 9.61 g kg⁻¹ was medium to high (table1 and Fig 1). High amount of organic carbon in these soils might be attributed to addition of biomass in terms of leaf litter, crop residues and cover crops helps in accumulation of organic matter in these soils. Wagh and Sayyed (2013)^[21] reported that organic carbon content of Panvel area of Konkan region varied from 5.9 g kg⁻¹ to 15.7 g kg⁻¹.

Available major nutrient status of soils

The available nitrogen content varies from 134.70 to 417.26 kg ha⁻¹ with average of 274.70 kg ha⁻¹ (table 2). The sufficient amount of nitrogen content in the lateritic soils might be due to high content of organic carbon which on mineralization released higher nitrogen content. Borkar *et al.* (2017)^[5] observed the available nitrogen content in lateritic soil of Konkan region ranged from 273.5 to 311.0 kg ha⁻¹. The nutrient indices of available nitrogen was observed in range form

The available phosphorus content varies from 3.08 to 14.25 kg ha⁻¹ with average of 8.25 kg ha⁻¹. These results were conformity with Deshmukh *et.al.* (2018)^[7] observed that the available phosphorus content in soils of Ratnagiri district varied from 2.4 to 18.8 kg ha⁻¹. The available potassium content varies from 171.58 to 631.00 kg ha⁻¹ with average of 390.68 kg ha⁻¹ indicated medium to high available potassium status. Salvi *et al.* (2017)^[17] reported the available potassium content in the soils from Dodamarg and Banda tehsils ranged from 117.48 to 451.22 kg ha⁻¹ with a mean value of 261.29 kg ha⁻¹. The nutrient index of available nitrogen was recorded in range from 1.30 to 1.60, available P 1.0 to 1.10 and available K, 2.70 to 3.00 (graph1)

Available molybdenum status of soils

Available molybdenum varied from 0.01 to 0.62 with mean of 0.25 mg kg⁻¹ (table 4 and fig 1). The nutrient index was recorded 1.82. However, out of eighty soil samples the 31 soil samples were found in low molybdenum, 38 soil samples were found in medium molybdenum and 11 soil samples were found in high molybdenum status of the district (table 5) The 38.75 per cent soil samples were recorded low in available molybdenum and 47.50 percent soil samples were recorded medium in available molybdenum (graph 1).

Table 1. The range and mean of physico-chemical properties of soils in Sindhudurg district of Maharashtra

S. N.	Name of Tehsil	pH (1:2.5)		EC (dS m ⁻¹)	
		Range	Mean	Range	Mean
1.	Kudal	5.11-6.91	5.93	0.08-0.29	0.14
2.	Sawantwadi	4.27-6.76	5.62	0.07-0.42	0.13
3.	Kankavli	5.18-6.69	5.71	0.05-0.25	0.11
4.	Devgad	5.02-6.73	5.58	0.04-0.22	0.18
5.	Malwan	4.62-6.71	5.57	0.05-0.26	0.20
6.	Vengurla	4.31-6.14	5.38	0.15-0.52	0.23
7.	Dodamarg	4.49-6.41	5.53	0.09-0.44	0.31
8.	Vaibhavwadi	5.18-6.52	5.73	0.06-0.55	0.30
	District	4.27-6.91	5.63	0.04-0.55	0.20

Table 2: The range and mean value of physico-chemical properties of soils in Sindhudurg district of Maharashtra

S. N.	Name of Tehsil	CaCO ₃ (%)		Organic carbon (g kg ⁻¹)	
		Range	Mean	Range	Mean
1.	Kudal	1.57-3.62	2.36	4.18-15.07	9.93
2.	Sawantwadi	2.12-4.37	2.85	4.09-12.60	9.47
3.	Kankavli	1.62-5.02	2.41	3.21-11.43	7.77
4.	Devgad	1.12-5.36	2.38	4.29-15.07	9.84
5.	Malwan	1.25-4.12	2.04	2.24-14.43	10.07
6.	Vengurla	1.75-3.87	2.58	3.70-15.85	11.10
7.	Dodamarg	1.37-4.18	2.74	5.39-15.36	10.52
8.	Vaibhavwadi	1.27-4.16	2.25	3.26-11.53	8.19
	District	1.12-5.36	2.45	2.24-15.85	9.61

Table 3: Range and mean value of available nutrient status of soils in Sindhudurg district of Maharashtra

S. N	Name of Tehsil	Available N (kg ha ⁻¹)		Available P (kg ha ⁻¹)		Available K (kg ha ⁻¹)	
		Range	Mean	Range	Mean	Range	Mean
1.	Kudal	161.0-378.1	287.09	3.08-9.66	6.16	174.1-620.7	469.37
2.	Sawantwadi	144.2-328.06	251.61	4.20-12.59	8.39	227.9-580.6	433.93
3.	Kankavli	135.8-294.3	231.06	6.22-9.90	7.77	171.5-574.4	370.70
4.	Devgad	195.2-412.0	314.47	6.50-14.25	9.53	261.3-472.9	388.32
5.	Malwan	159.7-388.3	297.72	4.12-13.14	9.09	218.3-631.0	394.60
6.	Vengurla	134.7-417.2	268.99	6.82-13.68	10.01	193.6-382.0	284.25
7.	Dodamarg	217.0-395.6	300.10	5.20-10.98	7.84	228.3-481.1	358.66
8.	Vaibhavwadi	150.6-295.5	246.58	3.79-9.92	7.26	240.5-531.1	425.64
	District	134.7-417.2	274.70	3.08-14.25	8.25	171.5-631.0	390.68

Table 4: Range and mean of available molybdenum status of soils in Sindhudurg district of Maharashtra

Sr. No.	Name of Tehsil	Mo (mg kg ⁻¹)		Nutrient indices
		Range	Mean	
1.	Kudal	0.04-0.62	0.27	2.5
2.	Sawantwadi	0.01-0.61	0.30	1.80
3.	Kankavli	0.06-0.59	0.30	2.00
4.	Devgad	0.02-0.55	0.19	1.70
5.	Malwan	0.03-0.48	0.20	1.50
6.	Vengurla	0.06-0.57	0.30	1.80
7.	Dodamarg	0.03-0.56	0.23	1.60
8.	Vaibhavwadi	0.06-0.57	0.28	1.70
	District	0.01-0.62	0.25	1.82

Table 5: Number and percent of soil samples of available molybdenum status of soils in Sindhudurg district of Maharashtra

Sr. No.	Name of Tehsil	low		Medium		High	
		No. of samples	Percent contribution	No. of samples	Percent contribution	No. of samples	Percent contribution
1.	Kudal	3	30.00	5	50.00	2	20.00
2.	Sawantwadi	4	40.00	4	40.00	2	20.00
3.	Kankavli	2	20.00	6	60.00	2	20.00
4.	Devgad	4	40.00	5	50.00	1	10.00
5.	Malwan	5	50.00	5	50.00	0	0.00
6.	Vengurla	4	40.00	4	40.00	2	20.00
7.	Dodamarg	5	50.00	4	40.00	1	10.00
8.	Vaibhavwadi	4	40.00	5	50.00	1	10.00
	District	31	38.75	38	47.50	11	13.75

Table 6: Karl Pearson's correlation coefficients of available molybdenum with various soil properties

Sr. No	Parameters	Available Molybdenum
1	pH	0.773**
2	Organic carbon	-0.639**
3	Available nitrogen	-0.516**
4	Available phosphorus	0.472**

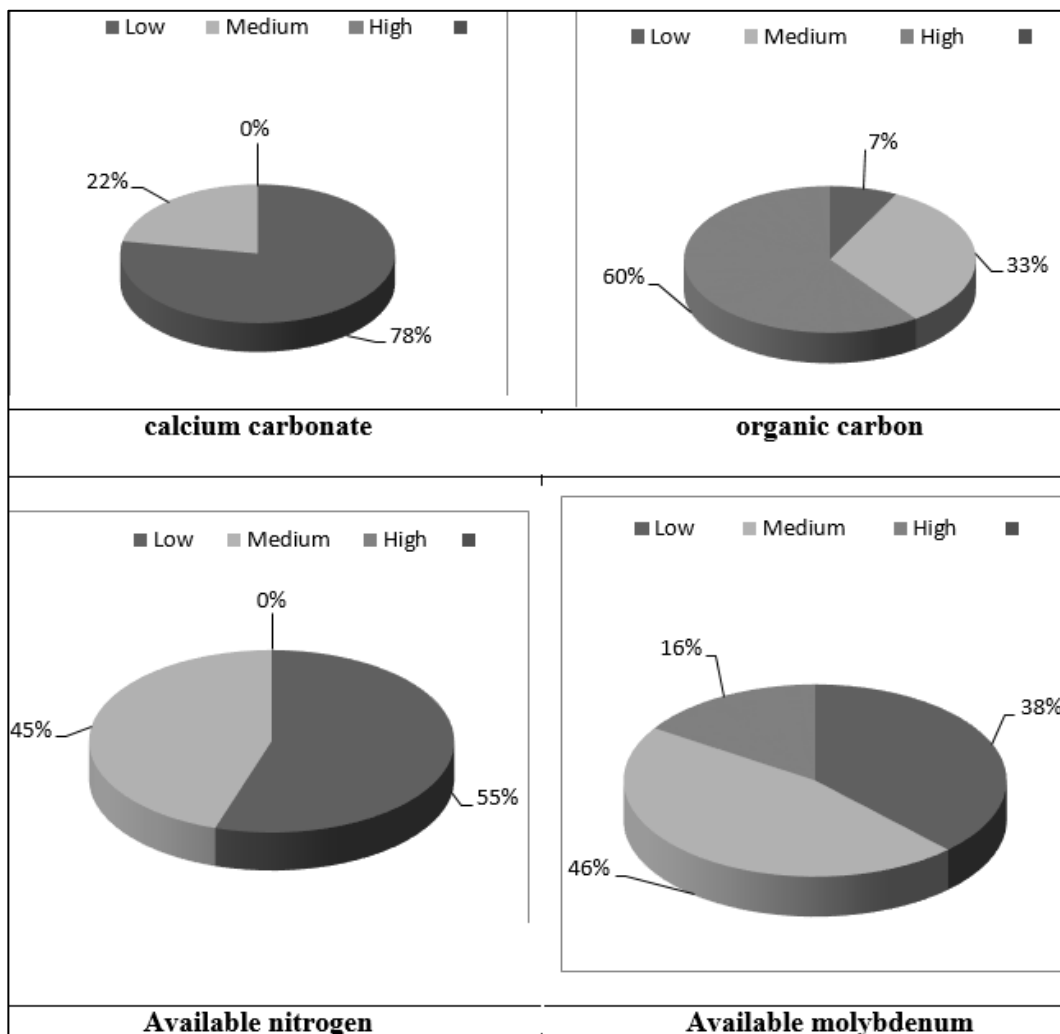
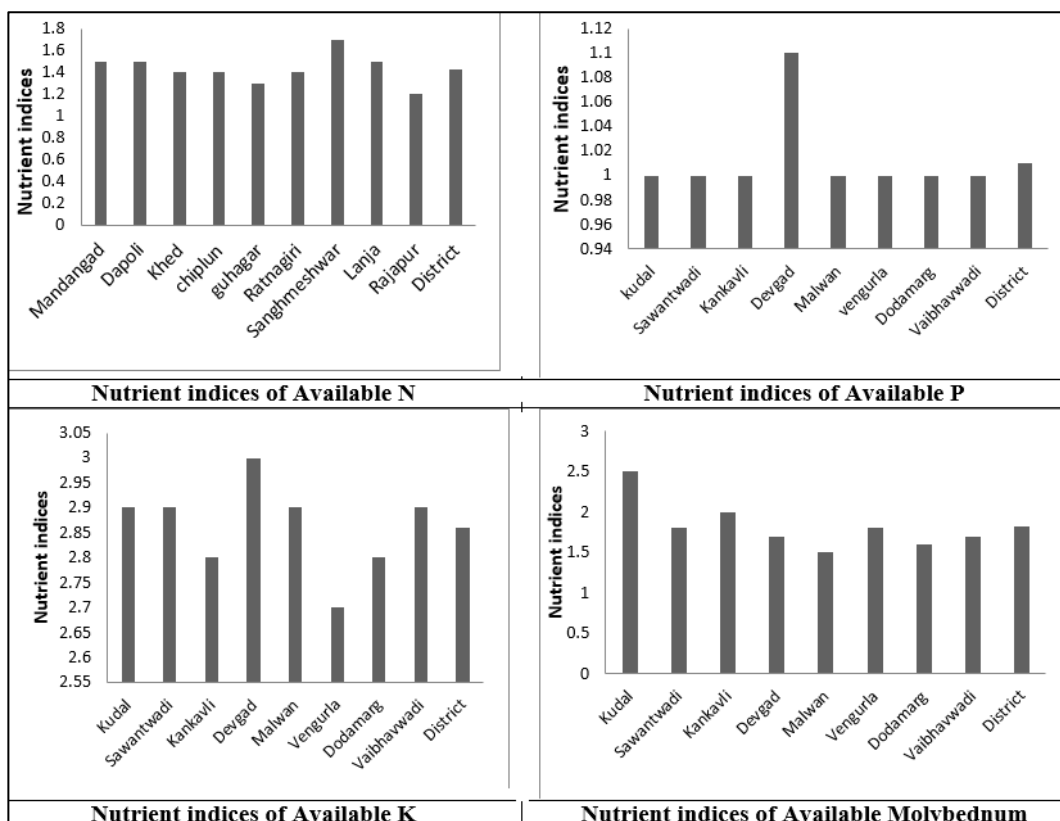


Fig 1: Status of available nutrients content in soils of Sindhudurg district of Maharashtra



Graph 1: Nutrient indices of available N,P K and molybdenum in soils of Sindhudurg district of Maharashtra

Correlation

The significant and positive correlation (table 6) of available molybdenum with pH ($r=0.773^{**}$), and available phosphorus ($r=0.472^{**}$) were found soils of Sindhudurg district (table 4). The similar significantly positive relationship between available soil pH with available molybdenum was also reported by Adriano (2001).

The significant and negative correlation of available molybdenum with organic carbon ($r = -0.639^{**}$) and available nitrogen ($r = -0.516^{**}$) were recorded in Sindhudurg district. The similar results reported by Rawat and Mathpal (1981)^[15] and observed that available molybdenum showed significant and negative correlation with organic carbon ($r = -0.341^{**}$).

Conclusion: It is concluded that, the available molybdenum status of Sindhudurg district was recorded varied from 0.01-0.62 mg kg⁻¹. However the 38.75% low and 47.50% medium soil samples were recorded in available molybdenum status of soils. The nutrient index for available molybdenum was recorded 1.82 of Sindhudurg district of Maharashtra.

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