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Secondary and micronutrient status of soil from *Kal amba* command area of konkan region of Maharashtra

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Abstract
An investigation entitled, "Secondary and micronutrient status of soil from *Kal Amba* command area of konkan region of Maharashtra" was conducted to study the secondary nutrients and micronutrients in the soil from *Kal Amba* command area. A total of 320 soil samples from sixty-four villages of Mangaon and Roha tehsil of Raigad district were collected randomly and were analyzed for the soil properties viz., Available Ca, Available Mg, Available S and Micronutrients viz., Fe, Mn, Zn and Cu by following standard analytical methods. The data revealed that the exchangeable magnesium, available iron and available zinc are found to vary. However, the soils are found to have sufficient amounts of available manganese and copper and have high amounts of exchangeable calcium and available sulphur.

Keywords: secondary, micronutrient, *Kal amba* command area, konkan

1. Introduction

The soil is a natural body, differentiated into horizons of mineral and organic constituents, usually unconsolidated, of variable depth, which differs from the parent material below in morphology, physical properties and constitution, chemical properties and composition, and biological characteristics. Soil is the most vital and precious natural resource that sustains life on the earth and it takes almost 1000 years to produce an inch of top soil (Chandra and Singh, 2009) [3]. It is a reservoir of nutrients and plays a pivotal role in supporting the growth of crops and other vegetation, maintaining the earth's environment clean. It also acts as a source and sink for atmospheric gases (Sharma and Dogra, 2011) [11].

A nutrient element is the one that is required to complete the life-cycle of an organism and its relative deficiency produces specific deficiency symptoms in the organism. In the soil, a nutrient element is distributed in different chemical forms, which often exist in a state of dynamic equilibrium and constitute the pool from which the plant draws it. Nutrients needed by the plant to complete its' life cycle is called 'essential nutrients' and depending upon the quantity required by the plant, nutrients are classified as macronutrients and micronutrients. Calcium, Magnesium and Sulphur are called as 'Secondary nutrients' and are not usually available in sufficient amounts and therefore are added through fertilization for the best growth of the plant. Nutrients that are required in relatively smaller quantities but are essential to the plant are termed 'Micronutrients' and include Fe, Mn, Zn, Cu, B, Mo, Cl and Ni. These nutrients required by the plants are supplied to them either from the soil minerals and soil organic matter or by organic and inorganic fertilizers (Shirgave and Ramteke, 2015) [12]. Macronutrients and micronutrient are important soil elements that control its fertility. The fertility status of soil indicates their nutrient supplying capability.

The Konkan region is characterized by humid, subtropical and monsoonic climate. The typical topography associated with high rainfall and other climatic conditions. *Kal Amba* irrigation project covers an area of 269.36 sq. km. of Roha and Mangaon tahsil of Raigad district of Maharashtra state. Mangaon and Roha are located on the banks of *Kal* river, a tributary of the Savitri river. Rice is the major crop of the two regions in kharif season because of the peculiar rainfall pattern whereas summer rice is grown only in the areas irrigated under *Kal* project. The soil also supports garden crops like arecanut, coconut, banana, sapota, etc. Therefore, in order to sustain their productivity, it is very much necessary for their proper management, which calls for determination of the fertility status of the soils. Hence, the present research work entitled "Secondary and micronutrient status of soil from *Kal Amba* command area of konkan region of Maharashtra" was undertaken.

2. Material and Methods

A total of 320 soil samples were collected randomly from the command area of *Kal Amba* project which falls under Mangaon and Roha tehsils of Raigad district. Sixty-four villages from Mangaon and Roha tehsil of Raigad district were selected for the study. Five farmers were selected from each village and five soil samples were collected at a depth of 0-15 cm by following standard method of collection of soil sample from each farmer's field to make one composite soil sample. Thus, there were five samples from each village which summed upto 320 samples from a total of 64 villages.

The Ca^{++} and Mg^{++} were determined titrimetrically by using 0.01 N Ethylenediamine tetra-acetic acid (Versenate solution) as given by Chopra and Kanwar, 1978. Available sulphur was determined turbidimetrically using soil: extractant in 1:5 proportion using 0.15 per cent $CaCl_2$ as an extractant. Turbidity developed by Barium chloride was measured spectrophotometrically at 420 nm wavelength (Chesnin and Yein, 1950) [5].

DTPA extractable Fe, Mn, Zn and Cu were extracted from the soil by Atomic absorption spectrophotometry method. The extracting solution used for this purpose consisted of 0.005 M DTPA (Diethylene Triamine Penta Acetic acid), 0.01 M $CaCl_2$ and 0.1 M TEA (Tri Ethanol Amine) buffered at pH 7.3 and concentration of these nutrients were determined with Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978) [7].

3. Results and Discussions

3.1 Secondary nutrients

The 320 soil samples collected from Roha and Mangaon Tehsils were analysed for their Secondary nutrients and the data is presented in Table 1 and discussed under the following subheads.

Table 1: Data of Secondary nutrients of soils from *Kal Amba* Command area

320Soil Sample	Secondary nutrients		
	Ca (meq 100 g^{-1})	Mg (meq 100 g^{-1})	S (mg kg^{-1})
Range	9.80-31.60	3.40-23.70	25.43-88.40
mean value	17.47	10.68	61.86

3.1.1 Exchangeable calcium

The analytical data related to the exchangeable calcium in (Table 1). The exchangeable calcium in the soil ranged from 9.80 to 31.60 meq 100 g^{-1} with a mean value of 17.47 meq 100 g^{-1}. Among the soil samples analysed, only 1 (0.312 %) was low and 319 (99.687 %) soil samples were high in exchangeable calcium (Table 2). It was observed from the study that the village Pingalsai Khurd had the highest (31.60 meq 100 g^{-1}) exchangeable calcium and Washi had the lowest (9.80 meq 100 g^{-1}) exchangeable calcium.

Table 2: Exchangeable calcium

Exchangeable Ca^{++} (meq 100 g^{-1})		No. of samples	Samples (%)
Class	Range		
Low	< 10	1	0.312
Medium	-	-	-
High	>10	319	99.687

3.1.2 Exchangeable Magnesium

The analytical data related to the exchangeable magnesium in the soil is given in (Table 1). The exchangeable magnesium in the soil ranged from 3.40 to 23.70 meq 100 g^{-1} with a mean value of 10.68 meq 100 g^{-1}. Among the soil samples analysed, 129 (40.3125 %) were low and 191 (59.687 %) soil samples were high in exchangeable magnesium (Table 3). It was observed from the study that the village Talashet had the highest (23.70 meq 100 g^{-1}) exchangeable magnesium and Ashtami had the lowest (3.40 meq 100 g^{-1}) exchangeable magnesium.

Table 3: Exchangeable magnesium

Exchangeable Mg^{++} (meq 100 g^{-1})		No. of samples	Samples (%)
Class	Range		
Low	< 10	129	40.312
Medium	-	-	-
High	>10	191	59.687

3.1.3 Available sulphur

The analytical data related to the available sulphur in the soil is given in (Table 1). The available sulphur in the soil ranged from 25.43 to 88.40 mg kg^{-1} with a mean value of 61.86 mg kg^{-1}. All (100 %) the soil samples of Roha and Mangaon tahsil analysed were high in the available sulphur (Table 4). It was observed from the study that the village Pugaon had the highest (88.40 mg kg^{-1}) available sulphur and Sangade had the lowest (25.43 mg kg^{-1}) available sulphur.

Table 4: Available Sulphur

Available S (mg kg^{-1})		No. of samples	Samples (%)
Class	Range		
Low	< 10	-	-
Medium	10-15	-	-
High	>10	320	100

3.2 Micronutrients viz., Fe, Mn, Zn and Cu status of the soil

The 320 soil samples collected from Roha and Mangaon Tehsils were analysed for their Micronutrients viz., Fe, Mn, Zn and Cu status of the soil and the data is presented in Table 5 and discussed under the following subheads.

Table 5: Data of available primary nutrients in soils from *Kal Amba* Command area

320 Soil Sample	Micronutrient			
	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Zn (mg kg^{-1})	Cu (mg kg^{-1})
Range	2.40-13.86	4.96-9.83	0.43-1.78	1.06-2.99
Mean value	8.36	6.99	1.23	2.39

3.2.1 Available iron

The analytical data related to the available iron in the soil is given in (Table 5). The available iron in the soil ranged from 2.40 to 13.86 mg kg^{-1} with a mean value of 8.36 mg kg^{-1}. Among the soil samples analysed, 8 (2.5 %) were deficient in available iron, 42 (13.125 %) had marginal availability and 270 (84.375 %) had sufficient available iron (Table 6). It was observed from the study that the village Chilhe had the highest (13.86 mg kg^{-1}) available iron and Pingalsai Khurd had the lowest (2.40 mg kg^{-1}) available iron. The soils are well supplied with available iron. This could be due to the peculiar weather conditions which have given rise to medium black soils in the region. Similar findings have been reported by Rajagopal *et al*. (1974) [9] and Taware (1983) [13].

Table 6: Available iron

Available Fe (mg kg^{-1})		No. of samples	Samples (%)
Class	Range		
Deficient	< 4.5	8	2.5
Marginal	4.5-5.6	42	13.125
Sufficient	>5.6	270	84.375

3.2.2 Available manganese

The analytical data related to the available manganese in the soil is given in (Table 5). The available manganese in the soil ranged from 4.96 to 9.83 mg kg^{-1} with a mean value of 6.99 mg kg^{-1}. Among the soil samples analysed, all the 320 (100%) soil samples were sufficient in available Mn (Table 7). It was observed from the study that the village Degaon had the highest (9.83 mg kg^{-1}) available manganese and Kharapatti had the lowest (4.96 mg kg^{-1}) available manganese. The study indicates that the soils are high in the available manganese content. Similar results have been reported by Yadav and Kalra (1964) [14], Salvi (1988) [10] and (Borkar *et al*. 2018) [2].

Table 7: Available Manganese

Available Mn (mg kg^{-1})		No. of samples	Samples (%)
Class	Range		
Deficient	< 2.0	-	-
Marginal	2.0-3.0	-	-
Sufficient	>3.0	320	100

3.2.3 Available zinc

The analytical data related to the available zinc in the soil is given in (Table 5). The available zinc in the soil ranged from 0.43 to 1.78 mg kg^{-1} with a mean value of 1.23 mg kg^{-1}. Among the soil samples analysed, 3 (0.937 %) were deficient in available zinc, 80 (25 %) had marginal availability and 237 (74.0625 %) soil samples were sufficient in available zinc (Table 8). It was observed from the study that the village Bhintad had the highest (1.78 mg kg^{-1}) available zinc and Morba had the lowest (0.43 mg kg^{-1}) available zinc which could be due to heavy leaching and typical climate of the region. Similar are the findings of Chavan (1980) [4] and (Borkar *et al*. 2018) [2].

Table 8: Available Zinc

Available Zn (mg kg^{-1})		No. of samples	Samples (%)
Class	Range		
Deficient	< 0.6	3	0.937
Marginal	0.6-1.0	80	25
Sufficient	>1.0	237	74.062

3.2.3 Available Copper

The analytical data related to the available copper in the soil is given in (Table 5). The available copper in the soil ranged from 1.06 to 2.99 mg kg^{-1} with a mean value of 2.39 mg kg^{-1}. Among the soil samples analysed, availability of Cu in all (100 %) soil samples was sufficient (Table 9). It was observed from the study that the village Vandoli had the highest (2.99 mg kg^{-1}) available copper and Pugaon had the lowest (1.06 mg kg^{-1}) available copper. The soils are well supplied with available copper and this could be due to the high content of clay having high amount of copper in black soils. Similar findings have been reported by Neelkanth and Mehta (1961) [8], Salvi (1988) [10] and Agrawal and Motiramani (1966) [1].

Table 9: Available Copper

Available Cu (mg kg^{-1})		No. of samples	Samples (%)
Class	Range		
Deficient	< 0.2	-	-
Marginal	0.2-0.6	-	-
Sufficient	>0.6	320	100

4. Conclusion

From the present investigation, it can be concluded that the soil from Mangaon and Roha tehsils of *Kal Amba* Command area of Konkan region of Maharashtra State has the exchangeable magnesium, available iron and available zinc are found to vary. However, the soils are found to have sufficient amounts of available manganese and copper and have high amounts of exchangeable calcium and available sulphur.

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