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Morphological, Nutritional and Mineralogical Status of Soil Samples Collected From Shirud Site of Shahada Tehsil of Nandurbar District

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Abstract: ***This study assesses the soil fertility status of some part of Shahada tehsil of Nandurbar District, Maharashtra. In total five soil samples were collected from nearby Shirud village and analyzed for the major soil physical and chemical properties. The study reveals that N, P and micronutrients are deficient in all the sampled profiles. The results of total and available N, P and K contents as well as total Fe, Mn, Cu and Zn contents in the soils were reported. Mineralogical studies are carried out with the help of XRD and SEM technique.***

Keywords: Soil, Fertility, pH, micronutrients

1. Introduction

Soil gives very important for natural resources and information on their characteristics, categorization, position, extend and distribution, potential and difficulty which are very important for any development, plan in specific area[1-5]. For food safety measures, good environment and good health of people the sustainable administration and land resources are important. Arbitrary exercise of resources joined with need of management which leads to degradation rumbling to concern of researchers, planner, farmers and others. Therefore to complete the future order, it is necessary to improve the soil output. So the information generated is usually interpreted for combination of soil for land potential, productivity of soil, and crop appropriateness. For best deployment of natural resources on sustained basis with the time and the appropriate information about the soil with respect to their nature, distribution, limitation, scope and potential are very significant.

To know the essential characteristics of soil, to establish the environmental & other relationship, to develop main guideline for the management of soil resources the objective of soil survey and mapping to organize the soil observation and knowledge is crucial[6-12].

To know the physical and chemical properties of soil, the categorization of soil series important for management of soil for crop yield. It observed that the definite physical and chemical properties of soil affect the productivity level and the storage of nutrients, soil moisture release, and penetration of root, nutrient ion release & fixation of nitrogen.

2. Material and Methods

An irrigated area nearby Shirud village of Shahada tehsil of Nandurbar district was selected for the study. Five samples (namely C1 to C5) were collected from the Shirud soil series and analyzed for their morphological nutritional and mineralogical status. The area under study is irrigated and intensively cultivated with commercial crops such as sugarcane, maize, wheat, cotton and banana grown alternatively.

2.1. Morphology

A measurement of soil depth takes place from the soil surface. The measurement of soil depth is takes place from the surface of the rock fragments Following Methods were used for morphological study of soil series:

- Soil Depth: Measurement of soil depth takes place from the soil surface.
- Soil color: Munsell notation as Hue Value and Chroma.
- Soil Structure: Soil sample was taken from the soil surface horizon and griped it gently.
- Soil Texture: Mechanical composition refers to the distribution of ultimate particle such as sand, silt and clay and not the aggregates present in the soil. They are classified quantitatively according to the size by two systems such as 1) International 2) USDA system.
- Particle size analysis: Bouyoukis Hydrometer method.
- Soil Consistence: Takings a soil ped between our forefinger and thumb and squeeze it till its pops or fall away from each other. If the soil is excessively dry spray a slight amount of water on it.

2.2. Physico Chemical Characteristics

Physico chemical characteristics were determined by using following standard reported methods.

- pH: pH Meter.
- EC: Electrical conductivity Meter.
- Organic carbon: Walkley and Black method.
- Calcium and Magnesium: By Versenate (EDTA) method.
- Chloride: Titrimetric Method
- Sulphate: Terbidimetric Method.
- Sodium: Flame Photometer Method.

2.3. Nutritional Status of Soil

- Major nutrients N, P, K and Micronutrients Fe, Mn, Cu, and Zn were estimated by following method.
- Available Nitrogen: By alkaline $KMnO_4$ method
- Available Phosphorous: By Olsen's method.
- Available Potassium: Flame Photometer Method.
- Boron: Carmine or Curcumine method.
- Micronutrients Cation Fe, Mn, Cu, and Zn: Determination of DTPA Extractable nutrient with the help of Atomic Absorption Spectroscopy method.

2.4. XRD and SEM Analysis

The mineralogical status of Shirud soil series of salt affected soil of Shahada taluka is estimated qualitatively. Analysis of the soil samples are carried out by different analytical methods and instrument in related laboratories. Identification minerals are takes place by X-ray diffraction (XRD) method, elemental composition of soil sample are detected by EDAX method and soil images are analysed by scanning electron microscopy (SEM) method.

The sophisticated XRD instrument automatically record all the value such as 2θ, d-spacing, wave length and counts required for detection of soil minerals. The d-value of X-ray Diffractogram of soil were estimated and compared with standard value of clay minerals supplied by the website- web meneral.com and other related references and their by the minerals present in soil sample are identified.

3. Results and Discussion

3.1 Morphology

Table 1: Morphological Characteristics of Shirud soil series

Sr. No.	Depth (cm)	Soil Color		Texture	Structure	Consistency	
		Dry	Moist			Dry	Moist
C1	148	10YR 4/1	10YR 3/1	scl	Moderate blocky	mh	fi
C2	138	10YR 3/1	10YR 2/1	sicl	Medium blocky	h	vfi
C3	140	10YR 4/1	10YR 3/1	scl	Moderate blocky	mh	fi
C4	130	10YR 3/1	10YR 2/1	sc	Medium blocky	h	vfi
C5	133	10YR4 /1	10YR 3/1	sicl	Moderate blocky	mh	fi

Discussion of results achieved during morphological study:

- C1: The color of soil at dry condition is brownish gray and at moist condition brownish black. Texture is sandy clay loam. The structure of soil is moderate blocky and diffuse wavy boundary. Consistency -when dry it is moderately hard and firm when moist. Very deep soil (148 cm).
- C2: The color of soil at dry condition is brownish black and at moist black. Texture is silty clay loam. The structure of soil is medium blocky. Consistency - when dry it is hard and very firm when moist, and diffuse wavy boundary. Very deep soil (138 cm).
- C3: The color of soil at dry condition is brownish gray and at moist condition brownish black. Texture is sandy clay loam. The structure of soil is moderate blocky and wavy boundary. Consistency -when dry it is medium hard and firm when moist. Very deep soil (140 cm).
- C4: The color of soil at dry condition is brownish black and at moist condition black. Texture is sandy clay. The structure of soil is medium blocky. Consistency - when dry it is hard and very firm when moist, and diffuse wavy boundary. Very deep soil (130 cm)
- C5: The color of soil at dry condition is brownish gray and at moist condition brownish black. Texture is silty clay loam. The structure of soil is moderate blocky and diffuse wavy boundary. Consistency -when dry it is moderately hard and firm when moist. Very deep soil (133 cm).

3.2 Physico Chemical Characteristics

The surface soil was collected for characterization of different physico chemical properties of salt affected soil of Shahada tahesil. These physico-chemical properties are pH, Organic carbon O.C., electrical conductivity EC, Exchangeable cation such as calcium, magnesium, sodium, and anions chloride and sulphate, Sodium absorption ratio SAR, exchangeable sodium percentage, are estimated and characterized by different analytical method. The estimated data are presented in the following table.

Table 2: Physico chemical characteristics of Shirud soil series

Series	O.C. %	pH	EC (dS/m)	Meq /L					SAR	ESP
				Ca^{2+}	Mg^{2+}	Na^{+}	Cl^{-}	SO_4^{2-}		
C2	0.39	8.61	1.980	18.52	8.51	34.2	0.485	0.383	13.20	15.41
C3	0.88	8.86	1.070	17.4	9.7	35.0	0.470	0.377	13.46	15.69
C4	0.95	8.63	1.150	18.6	8.9	34.9	0.442	0.340	13.32	15.54
C5	1.06	9.01	1.727	16.8	10.4	35.8	0.448	0.352	13.80	16.05
Average	0.726	8.79	1.601 4	17.924	9.302	35.156	0.475	0.369 4	13.504	15.67

Soil pH vary 8.61 to 9.01 of C2 and C5 locations respectively are recorded from the soil series C (Shirud) agricultural soil area are observed to be strongly alkaline range of soil pH. This range of pH is not very broad. The

strong alkalinity of soil may be due to gathering of surplus amount of sodium, magnesium and a little salt such as sulphate, chloride, bicarbonate and average pH of this series is 8.79 which give an idea about the consequences that the soil is strongly alkaline in quality.

Electrical conductivity recorded varies from 1.01 to 2.08 dS/m of C3 and C1 locations respectively of the soil series Shirud (C) agricultural soil area. It indicates that the soil is moderately saline.

The content of organic carbon in Shirud (C)agricultural soil are a series ranges from 0.35 percent at C1 location to 1.06 percent at C5 location of Shirud village soil field. It ranges from low to very high percentage of organic carbon content status.
Exchangeable calcium of C (Shirud) village field soil ranges from 16.8 to 18.6 meq/L of C5 and C4 respectively. It is low range in rating of exchangeable calcium. High pH may be due to prolonged and continuous use of sodic water for irrigation which creates sodicity and salinity problem.

Exchangeable magnesium of C (Shirud) village soil field ranges from 8.51 to 10.4 meq/L of C2 and C5 respectively. It is medium range in rating of exchangeable magnesium. Average exchangeable magnesium is 9.302 meq / L. reported medium.

Exchangeable sodium of C (Shirud) village field soil ranges from 34.2 to 35.88 meq/L of C2 and C1 respectively. It is high range in rating of exchangeable sodium. Average exchangeable sodium is 35.156 meq / L.

Sodium absorption ratio of this soil series ranges from 13.2 and 13.8 of C2 and C5 soil location respectively and average SAR of this soil series reported 13.504 which suggest that soil contains high concentration of sodium. The exchangeable sodium percentage ESP of this soil series ranges from 15.41 to 16.05, and average ESP is 15.67 indicates soil is alkaline in condition, for this reason pH and exchangeable sodium in this soil series is high.

It is observed that chloride contents of C (Shirud) village agricural soil ranges from 0.442 to 0.53 meq/L of C4 and C2 location respectively. An average chloride is 0.475 meq/L. Sulphate of C (Shirud) village agricultural soil varies from 0.34 to 0.395 meq/L of C4 and C1 location respectively. An average sulphate is 0.3694 meq/L. From these reported values of chloride and sulphate, it is observed that rating of chloride and sulphate in this series is medium. All the related average value of salt it is observed that the soil of this series is alkaline in nature. The related parameters are average value of both chloride and sulphate, average pH, EC, SAR and ESP. Chief reason may be irrigation water, presence of alkali minerals in the soil and parent rock basalt.

3.3 Nutritional Status of Soil

All these soil samples are studied quantitatively for their nutritional status such as Available nitrogen, phosphorous, and potassium, micro-nutrients such as iron, copper, manganese, zinc, boron and sulphate are presented in table-6.

Table 3: Status of Available nutrients in Shirud soil series

Soil Series	Available Nutrients (Kg/h)			Available micronutrient (ppm)				
	N	P	K	Fe	Cu	Mn	Zn	B
C2	174.72	16.56	467.04	4.21	0.67	14.24	0.76	1.21
C3	392.0	11.42	556.64	9.51	0.78	17.18	0.96	1.42
C4	423.36	20.60	491.68	9.22	0.52	18.23	1.51	1.15
C5	474.88	23.00	465.56	7.17	0.37	15.73	0.83	0.96

The available nitrogen status of salt affected soil of C (Shirud) soil series ranges from 154.56 to 474.88 Kg/ha at C1 and C4 soil location respectively. Among these soil C1 location has low and B5 soil location has medium available nitrogen according to soil rating of available nitrogen. The available phosphorous status of this soil series ranges from 11.42 to 23.0 Kg/ha at C3 and C5 soil location respectively. According to rating of available phosphorous both these location has medium available phosphorous. The range of available potassium is from 465.56 to 556.64 Kg/ha at C5 and C3 soil location respectively. According to standard rating of available potassium, the C5 and C3 soil location has very high available potassium.

The range of extractable iron of this soil series is from 4.21 to 9.22 ppm at C2 and C4 soil location respectively. According to standard rating of extractable iron, the C2 location has very low and C4soil location has medium extractable iron. Average extractable iron contains of this soil series is 6.96 ppm. The range of extractable copper of this soil series is from 0.37 to 0.78 ppm at C5 and C3 soil location respectively. According to standard rating of extractable copper, both the C5and C3 soil location has low extractable copper. The range of DTPA extractable Manganese of this soil series is varies14.24 to 18.23 ppm at C2 and C4 soil location respectively. The range of extractable zinc of this C (Shirud) soil series is from 0.75 to 1.51 ppm at C1 and C4 soil location respectively. Range of this series is narrow and according to standard rating of extractable zinc. The range of available boron of this soil series is varies0.96 to 1.6 ppm at C5 and C1 soil location respectively. The range of available boronis narrow.

3.4 XRD and SEM Analysis

The mineralogical status Shirud (C) soil series of Shahada taluka is estimated qualitatively by XRD and SEM. Results of XRD analysis are presented in Table:

Table 4: Minerals Observed from XRD Peak Intensity

Sr.	Minerals Observed from XRD Peak Intensity			
C	Jinshajiangite	Tazheranite	Hongshite	Tunellite
	Franzinite	Clinoferrosilite	Bityite	Crichtonite
	Chaoite	Denisovite	Pirssonite	Quadruphite-VIII
	Kelyanite	Leadamalgam	Mayingite	Brammallite
	Heulandite-Sr	Ferdisilicate	Glucine	Bariosincosite
	Quintinite	Calderite	Maricite	Schachnerite
	Crafordite	Dansite	Mohrite	Zincgortrellite
	_____	N-sutite	Krasnogorite	Bastnasite-Y
	_____	_____	Dissakisite	Perlialite

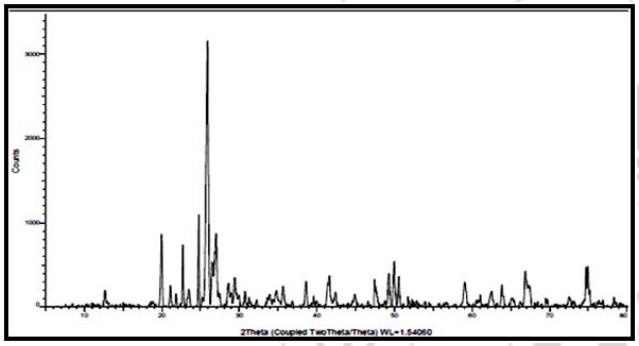


Figure 1: XRD difractogram of soil sample collected from Shirud soil series

It is observed that the dominant minerals present at C (Shirud) soil series are, Jinshajiangite, Franzinite, Chaoite, Kelyanite, Heulandite-Sr, Quintinite-2H, and Crawfordite at the characteristic d-spacing values 3.442, 3.591, 4.4442, 3.304, 3.909, 1.823 and 2.172 A^{o}respectively.The medium minerals existing at Shirud (C) soil series are Tazheranite, Quartz, Denisovite, Leadamalgam, Ferdisilicate, Calderite, Dansite and N-Sutite at the distinguishing d-spacing values 1.803, 3.352, 3.033, 1.396, 1.847, 1.562, 3.117 and 2.330A^{o}respectively.

SEM images and EDAX revealed that few element affinity groups occur, some elements are C, O, Na, Si, Ca, Fe, Br, Hg, Here the mineralogical relationship is associated these elements are carbon being associated with Chaoite and Crawfordite and Quintinite. O, Na, Si and Ca being associated with Jinshajiangite, Franzinite, heulandites and related weak and trace minerals. Fe being associated with Jinshajiangite and other related weak and trace minerals. Br and Hg being associated with Kelyanite and other related minerals. The structural determination with help of SEM images suggested that most of the minerals images are layered flakes and fluffy in square and irregular spheroid shape.

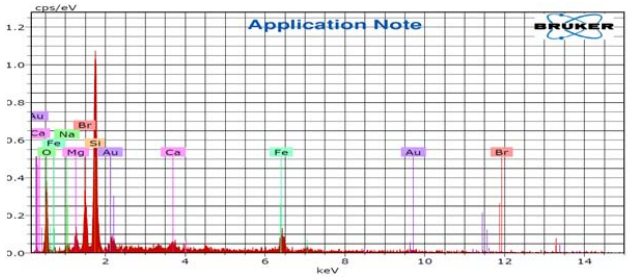
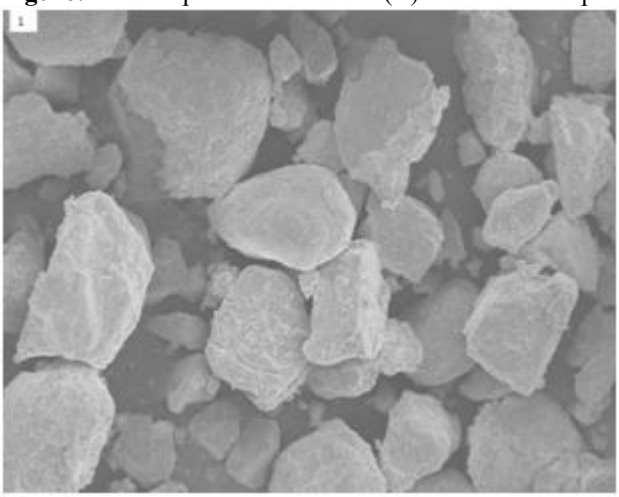
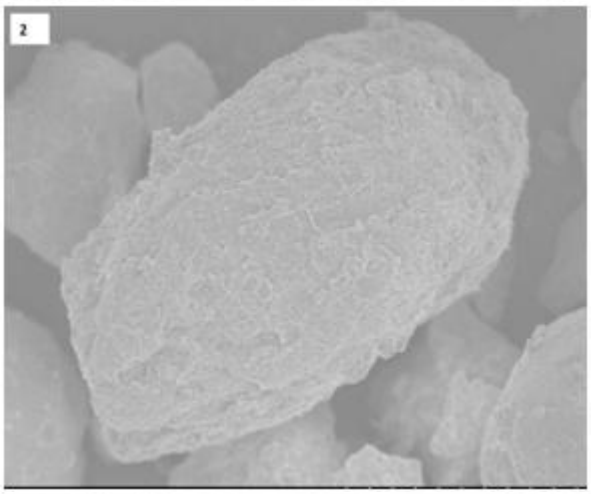
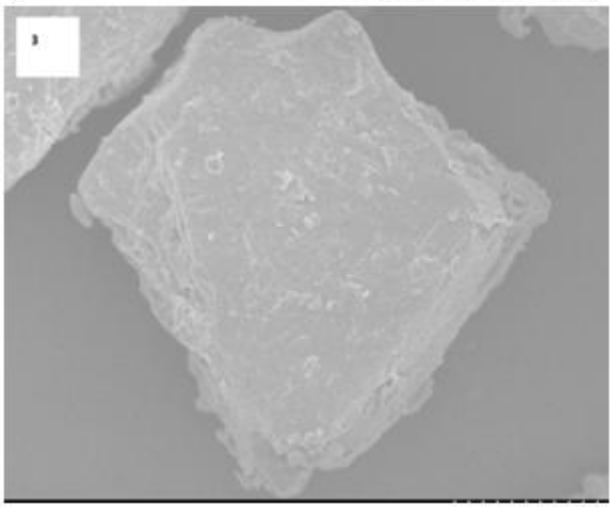


Figure: EDAX spectrum of Shirud (C) series soil sample







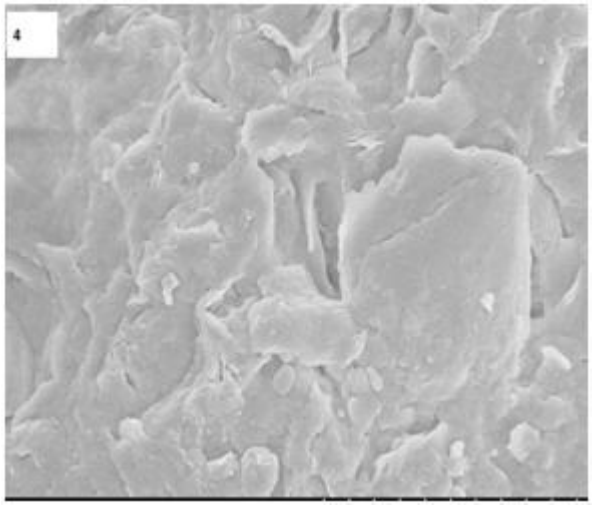


Figure 2: SEM images at different magnitude of Shirud soil series sample

4. Conclusion

In the present study morphological study reveals that Soil from Shirud soil series of Shahada tahesil has Basalt as a Parent material, Drainage and permeability of soil is Moderate and slowly permeable, Productivity Potential is Medium. Average Electrical conductivity suggests that the soil is saline. Average organic carbon content is 0.726 percent which is moderate. Average exchangeable calcium is 17.924 meq / L. reported low. Average exchangeable magnesium is 9.302 meq / L reported medium. Average exchangeable sodium is 35.156 meq / L. Average SAR of this soil series reported 13.504 which suggest that soil contains high concentration of sodium. Average ESP is 15.67 indicates soil is alkaline in condition. Average available potassium contains of this soil series is 494.52 Kg/ha.The average available nitrogen and average available phosphorous contents of this soil series is medium while potassium content is very high, Average extractable Manganese, zinc and boron content is very sufficient and Average extractable iron contains of this soil series is 6.96 ppm it has also low. From XRD analysis it is observed that the dominant minerals present at C (Shirud) soil series are, Jinshajiangite, Franzinite, Chaoite, Kelyanite, Heulandite-Sr, Quintinite-2H, and Crawfordite at the characteristic d-spacing values 3.442, 3.591, 4.4442, 3.304, 3.909, 1.823 and 2.172 A^{o} respectively.SEM images and EDAX revealed that few element affinity groups occur, some elements are C, O, Na, Si, Ca, Fe, Br, Hg, Here the mineralogical relationship is associated these elements.

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