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Micronutrient status and its correlation with chemical properties of soils of Jalgaon district, Maharashtra

Monika Naphade, Rajshri Shinde, Anjali Mendhe and RT Suryavanshi

Abstract
The available forms of nutrients governs the fertility of soil and controls the productivity of crops but this is influenced by pH, EC, organic carbon and $CaCO_3$ status of soil. A study was conducted to assess available nutrient status and their relationship with chemical properties of soils of Jalgaon district by GIS technique. Studies were conducted to know the status of available micronutrient in relation to chemical properties in soils of 15 tehsils of Jalgaon district. From each tehsil, five villages were selected and from each village, six farmer fields were randomly selected during the year 2019-20. In a total of 450 geo-referenced surfaces (0-22.5 cm), soil samples were collected from the Jalgaon district by using a systematic sampling methodology based on GPS. The data show that these soils were slightly acidic to moderately alkaline in reaction, safe in EC, very low to very high in organic carbon, and low to very high calcareous in nature. Considering soil nutrient index value these soils were low in Fe and Zn and high in respect to Mn and Cu. The pH of the soil was non-significantly and negatively correlated with DTPA extractable Fe (r = -0.011), Mn (r = -0.010), Zn (r =-0.092) and Cu (r = -0.002). EC of the soil was highly significantly and positively correlated with Mn (r=0.283) and Cu (r = 0.224) and negatively significantly correlated with Zn (r = -0.224). The EC was negatively as well as non-significantly correlated with available Fe (r = -0.043). Organic carbon showed a positive non-significantly correlation with available Cu (0.001). However, non-significantly and negatively correlated with Fe (-0.024) and Zn (r = -0.053), and highly non-significantly and negatively correlated with available Mn (r = -0.001). The value of $CaCO_3$ showed a positive but non-significant correlation with available Mn (0.002), while negative as well as non-significant relation with available Fe (-0.013), Zn (-0.012) and Cu (-0.026).

Keywords: Geographic information system (GIS), global positioning system (GPS), soil fertility status, correlation coefficient, DTPA

Introduction

Soil fertility is one of the important factors controlling yields of the crops. A critical feature of the production of sustainable agriculture is the characterization of the soil in relation to the assessment of the fertility state of the soils in a certain area or region.

The nation's critical population crisis necessitates the highest feasible yield of food, fibre, and fuel from each cultivated land area per unit of time. Soil test findings from one farm must be comprehensive in order to be related to the larger population of all farms in a particular area. The ideal scenario would be to sample every farm in order to determine the soil fertility condition of all the farms, but this is not possible due to the high expense, difficulty, and time involved, especially given the widespread practise of many small farm holdings in developing nations. The micronutrient deficiencies in various crops of the Khandesh region has increased markedly in recent years and pinioned that it might be due to continuous and intensive multiple cropping and use of high yielding cultivars which may have higher micronutrient demand, enhanced production of crops on marginal soils that contain low levels of essential nutrients, increased use of high analysis fertilizers with low amount of micronutrient contamination, decreased use of organic manures *viz*; animal manures, composts and crop residues, use of soils that are inherently low in micronutrient reserves and involvement of natural and anthropogenic factors that limit adequate plant nutrient availability and create element imbalances. Thus, there are several advantages to be had when creating soil fertility maps using modern technology like GIS and GPS. Within one field, different soils have different chemical and physical characteristics. When it comes to land development, environmental protection, and restoration in agriculture, spatial tools like the Global Positioning System (GPS) and Geographic Information System (GIS) for gathering and processing spatial data can be very helpful. Farmers use variable rate technology to apply the right amounts of input in various regions of the field while using GPS and GIS as yield monitors in precision agriculture. The precise distribution of fertiliser compounds can be managed by farmers using GPS to pinpoint nutrient deficits. With a specific address, GPS can provide an appropriate location on Earth (its precise location). A GIS is basically a descriptive database of the earth or a specific part of the earth. GPS-GIS are advanced tool for studying on site specific nutrient management which can be efficiently use for monitoring soil fertilization in Jalgaon district (M.S.) and would be useful for ensuring balanced fertilization to crops. The right metabolic transformation within the plant body is required by the micronutrients in order to produce the desired end product. While Mn is necessary for photosynthesis, carbon absorption, and nitrogen metabolism, Fe aids in photosynthesis. Cu is a component of cytochrome oxidase, while Zn is necessary for the formation of auxin and proteins. Each micronutrient component is crucial to the growth of plants. Both physiological systems and plant metabolism benefit from their importance. Through their participation in numerous enzymes and other physiologically active molecules, iron, manganese, zinc, and copper are essential micronutrients for plant growth. These micronutrients are important for gene expression, the biosynthesis of proteins, nucleic acids, growth factors, chlorophyll, and secondary metabolites, the metabolism of carbohydrates and lipids, stress tolerance, etc. Soil fertility is one of the important factors controlling yield of crops characterization in relation to evaluation of fertility status of soil of an area is important aspect. Keeping these view and also lack of information on micronutrient status to identify the emerging micronutrient deficiency or toxicity in soils, therefore a comprehensive study was undertaken by using GPS-GIS for evaluation of micronutrient status of soils and their relation with chemical properties of soils of Jalgaon tehsil.

The chemical properties of soils play an important role in determining the retention, and availability of nutrients in the soils. The nutrient supply in soils is depends on the level of organic matter, calcium carbonate, degree of microbial activity, change in pH, types and amount of clay and status of soil moisture (Zende, 1984) [54]. Maharashtra are clayey in texture, neutral to alkaline in reaction, low to medium in organic carbon and non-calcareous to calcareous in nature (Gajbe *et al.*, 1976) [11]. Further Malewar (1994) [30] reported that large area of Maharashtra is under Zn and Fe deficiency. Deficiency of Zn, Mn and Cu is spreading in soils at faster rate due to intensive cropping, imbalance fertilizer use and lack of efficient management. Hence, it is important to maintain soil health for sustainable productivity, food security and increasing agricultural production for multiple demands against fast mounting pressure on limited soil resource base. Therefore, the present study was conducted to study the status of micronutrients available in relation to some chemical properties.

Material and Methods

Study area the Jalgaon district was spread over 20^0 15' to 21^0 90'north latitudes and $73^0$42' and $76^0$28' east longitude and situated at an elevation of 225 m (738 ft.) above mean sea level. It is spread over an area of 11,765 km² with a population of 4,229,917 (2011 census data). Jalgaon, earlier known as East Khandesh until 21st October 1960 is a one of the biggest and agriculturally important district of Maharashtra, India. It is bounded by the state of Madhya Pradesh in the north and by the districts of Buldhana in the east, Jalna in the southeast, Aurangabad in the south, Nashik in the southwest, and Dhule in the west. (Fig 1)

Geology

Geologically it is the part of the basaltic Deccan trap that covers almost the whole district, except for a few strips of alluvium on both sides of the major streams. These rocks are formed by an outpouring of an enormous lava flow that has spread over a vast area at the end of the Mesozoic era. The basalt contains innumerable cavities which are usually filled with secondary minerals such as quartz, agate, jasper, zeolites, and calcite. Alluvium patches found along the river valleys are thick and wide on the west but the capping becomes thicker in the east. The topography is typical of the Deccan lavas, with remaining hill ranges and large valleys, as well as short chains of hillocks created by trap dykes. (Vijesh[a], 2013) [52].

Hydrology

Purna in the south and Bhokar, Suki, Morna, Harki, Manki, and Gul in the north are the primary tributaries of the Tapi River, which flows through the district. From the north, the Girna River flows through Jalgaon. It has a total length of 130 kilometers in Chalisgaon, Bhadgaon, Pachora, and Erandol tehsils, and a total length of 88 kilometers in Jamner and Bhusawal tehsils. The Agnavati river flows through Pachora tehsil, the Anjani river flows through Ernadol tehsil, the Bori river flows through Amalner and Parola tehsils, and the Mor river flows through Yawal tehsil in Jalgaon district, with a total length of 48 kilometres. In addition to this Suki, Hiram, Bhula, and Minyad are minor tributaries of these rivers.

Climate

Climatologically, Jalgaon district falls in hot semi-arid Eco region and receives 77 to 80 cm of rainfall per annum. District receives an average rainfall of about 690 mm. The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. Over the course of the year, the temperature typically varies from 10.8 °C to 42.2 °C and is rarely below 10 °C or above 45 °C. The area therefore, qualified for "hyperthermic" temperature regime.

Agro-climatic zone

Due to soil type and rainfall pattern the Jalgaon district is divided into two broad agro climatic zones i.e. Zone VII (Assured Rainfall Zone-AR) having light to medium soils and fertile medium to heavy soils consisting of 8 blocks and minimum area under Zone VI (Scarcity zone-SC) consisting of 7 blocks. In these zones the cropping pattern is different.

Land Use and Natural Vegetation

The main agronomical crops are grown in kharif season *viz.* cotton, sorghum, bajra, maize, soybean, green gram, red gram. The crops are grown in Rabi season *viz.* wheat, maize, gram and chilli etc. Today, Jalgaon district is known as cotton and banana bowl of the State, as 4 lakh ha is under cotton and 48000 ha is under banana crop. The main horticultural crops *viz.*, fruits like papaya, banana, ber, custard apple, pomegranate, citrus, guava, lemon, sweet orange and vegetables are Brinjal, onion, chilli, etc. Natural vegetation comprises of dry deciduous species (Eucalyptus, neem etc.). Other trees like Sag/Teak, Dhawada, Shisam, Khair, Tendu, Palas, Anjan, Ber and Bamboo are observed in this region.

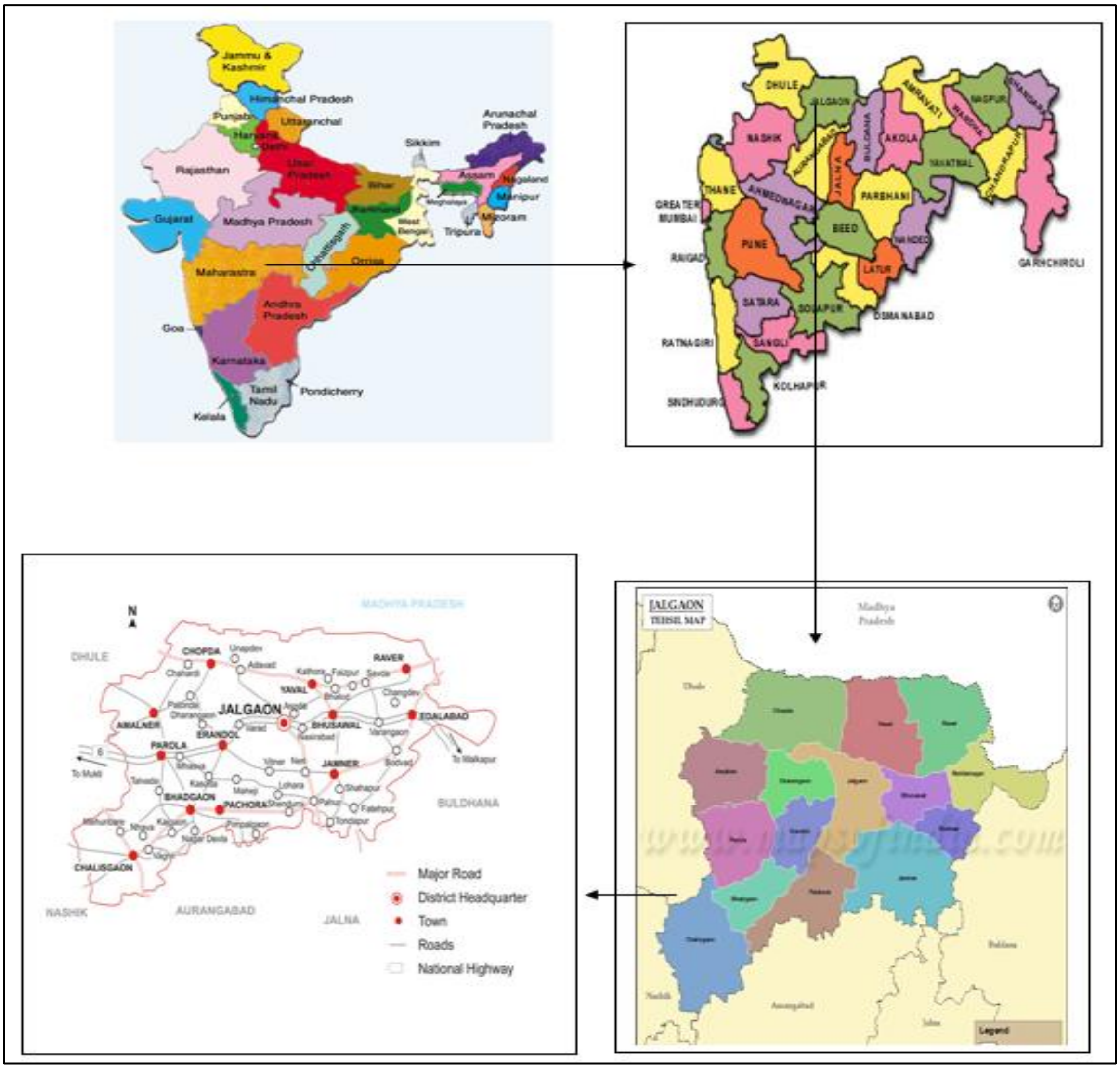

Fig 1: GPS-GIS based map showing location of Jalgaon district

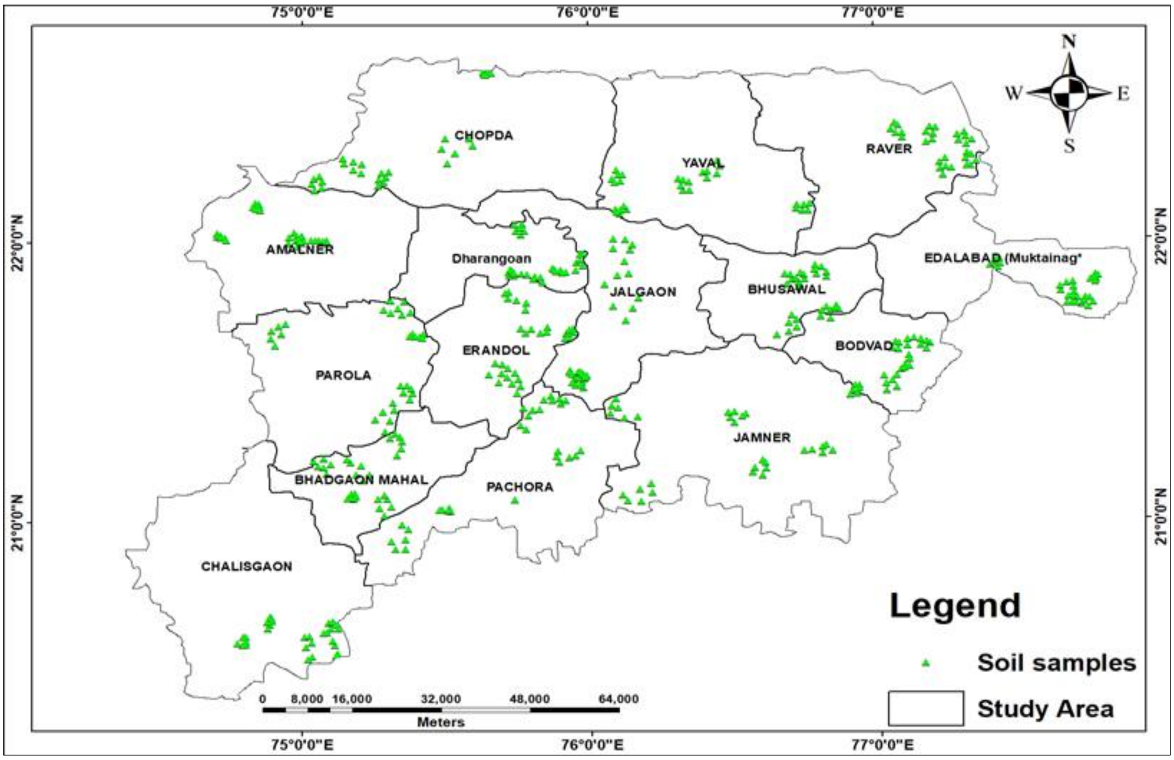

Fig 2: Base map of Jalgaon district

Physiography

The study region of Jalgaon district can be split into three primary physiographic divisions: Satpura hill ranges in the north with dense forest; Tapi valley with alluvial plain in the canter; and Ajanta hill ranges flanking the hill ridges and minor valleys in the south.

Methodology

Soil sample collection and analysis

The Jalgaon district comprises of 15 tehsils. From each tehsil, five villages were selected and from each village, six farmers were randomly selected during the year 2019-20. So in all total 450 surface (0-22.5 cm depth) soil samples were collected and the exact sample location was recorded using a GPS by adopting standard procedure outlined by Yadav and Khanna (1965) [55]. The data presented in Table 1 and fig 2.

Soil samples were analyzed for chemical characteristics by following standard analytical techniques. Soil reaction was determined in 1:2.5 suspensions using standard pH meter by Potentiometry (Jackson, 1973) [15]. The electrical conductivity was determined by 1:2.5 suspension using EC meter by Conductometry (Jackson, 1973) [15]. Soil organic carbon was estimated using wet oxidation method (Nelson and Sommer, 1982) [35] and $CaCO_3$ is determined by Acid neutralization method by Alison and Moodie (1965) [3]. Soil available N determined by modified alkaline permanganate method (Subbiah and Asija, 1956) [46], available P by 0.5M NaH_4CO_3 method (Watanabe and Olsen, 1965) [50] and available K by Flame Photometer ((N *N*NH_4OAC) pH (7.0) method (Jackson, 1973). Available S determined by 0.15% $CaCl_2$ extractable method described by William and Steinberg (1969) and Available Micronutrients i e Fe, Mn, Zn and Cu (mg/Kg) determined by Atomic-Absorption Spectrophotometer (Extracted with DTPA) method by Lindsay and Norvell (1978) [25].

Table 1: Soil sampling from 15 tehsils of Jalgaon district.

Sr. No.	Name of Tehsils	Total Villages	Number of samples			Location	
			Model villages under each tehsils	No of Soil Sample From villages	No of samples	Latitude (N)	Longitude (E)
1	Amalner	155	5	6	30	21.04901	75.05310
2	Bhadgaon	60	5	6	30	21.12724	74.22122
3	Bhusawal	54	5	6	30	21.04556	75.11947
4	Bodvad	53	5	6	30	20.90190	76.01743
5	Chalisgaon	144	5	6	30	20.46031	75.01123
6	Chopda	120	5	6	30	21.23632	75.29149
7	Dharangaon	90	5	6	30	20.98682	75.24405
8	Erandol	66	5	6	30	20.92657	75.33247
9	Jalgaon	88	5	6	30	21.00419	75.56394
10	Jamner	160	5	6	30	20.80937	75.77892
11	Muktainagar (Edlabad)	85	5	6	30	20.66710	75.34868
12	Pachora	129	5	6	30	20.67000	75.35000
13	Parola	117	5	6	30	20.88100	75.11942
14	Raver	119	5	6	30	21.25000	76.02999
15	Yawal	93	5	6	30	21.17091	75.70021
		1533	75	90	450		

Statistical analysis

The soil chemical properties data were statistically analyzed by using standard statistical methods given by Panse and Sukhatme (1985) [38].

Result and Discussion

Categorization of Soil Properties and Nutrient Status

Table 2: Soil pH, EC, Organic carbon and $CaCO_3$ status of Jalgaon district.

<table>
<tr><th>Particulars</th><th>pH
(1:2.5)</th><th>EC
(dS m⁻¹)
(1:2.5)</th><th>Organic Carbon
(g kg⁻¹)</th><th>CaCO3
(g kg⁻¹)</th></tr>
<tr><td>Mean</td><td>7.74</td><td>0.79</td><td>11.11</td><td>66.06</td></tr>
<tr><td>Range</td><td>6.79-8.85</td><td>0.14-2.38</td><td>2.35-25.80</td><td>1.25-184.76</td></tr>
<tr><td rowspan="5">Category</td><td>Extremely acidic
0
(0.00)</td><td rowspan="2">Normal
355
(78.88)</td><td>Very low
28
(6.22)</td><td>Very low
2
(0.4)</td></tr>
<tr><td>Strongly acidic
0
(0.00)</td><td rowspan="2">Low
35
(7.77)</td><td rowspan="2">Low
6
(1.33)</td></tr>
<tr><td>Moderately acidic
0
(0.00)</td><td rowspan="2">Poor seed emergence
90
(20.0)</td></tr>
<tr><td>Slightly acidic
13
(2.88)</td><td>Moderate
51
(11.33)</td><td>Moderate
51
(11.33)</td></tr>
<tr><td>Neutral
17</td><td>Harmful to some crops e.g. Pulses
5</td><td>Moderately High
38</td><td>Moderately High</td></tr>
</table>

	(3.77)	(1.11)	(8.44)	64 (14.22)
	Slightly Alkaline 278 (61.72)			
	Moderately Alkaline 142 (31.55)	Harmful to most of the crops 0 (0.00)	High 61 (13.51)	High 281 (62.44)
	Strongly Alkaline 0 (0.00)		Very high 237 (52.66)	Very high 46 (10.22)
	Very strongly Alkaline 0 (0.00)			

(Total number of soil samples analyzed- 450, figures in parenthesis expressed in per cent).

Soil reaction (pH)

The data (Table 2) and (Figure 3) shows that soil pH ranges from 6.79 to 8.85 with a mean of 7.74. Among the 450 soil samples tested, 13 samples (2.88%) were slightly acidic, 17 samples (3.77%) were neutral, 278 samples (61.72%) were slightly alkaline and 142 samples (31.55%) were moderately alkaline. Investigated soils are normal to alkaline in reaction with pH varied from 6.79 to 8.85 across the district. This might be attributed to the basaltic trap parent material basic in nature, from which these soils are formed. The higher content of ferromagnesian minerals in basaltic trap material might have resulted in the alkaline soil reaction. Hadole *et al*., (2019) [14] also reported a similar range of soil pH varying from 6.97 to 8.87 across the Jalgaon district. These findings were also supported by the observations of Chaudhari and Kadu (2007) [7], Ingle *et al*., (2017), Padole and Mahajan (2003) [36], Waikar *et al*., (2004) [48], Jibhakate *et al*., (2009) [17] and Desmukh (2012) [9] mostly in adjoining of the study area.

Electrical conductivity (EC)

The data on the electrical conductivity of soils are presented in Table 2 and depicted in Fig. 3. The EC values of soil samples collected from Jalgaon district were ranged from 0.14 to 2.38 dS m^{-1}, The mean of EC for all soil samples was 0.79 dS m^{-1}. It is observed that 355 (78.88%) soil samples were non-saline, 90 (20%) soil samples were critical for soil sensitive crops and resulted in poor seed emergence, whereas, 5 (1.11%) soil samples were harmful to all crops. The normal values of EC are recorded on upstream and topographically higher areas which can be attributed to the rolling topography, relatively higher gradient, seasonal irrigation and alternate cropping pattern. Similar findings were also reported by Kondvilkar *et al.*, (2017) [23] and Golhar and Chaudhari (2013) [13]. Many researchers from the study area and other adjoining regions of Maharashtra emphasized that non-judicious use of water resulted in a build-up of high total soluble salt concentration in black cotton soils, Waikar *et al*., (2004) [48], Patil and Sonar (1994) [40], Binita *et al*., (2009) [5], Mahashabde and Patel (2012) [27] and Nalawade and Palwe (2014) [34].

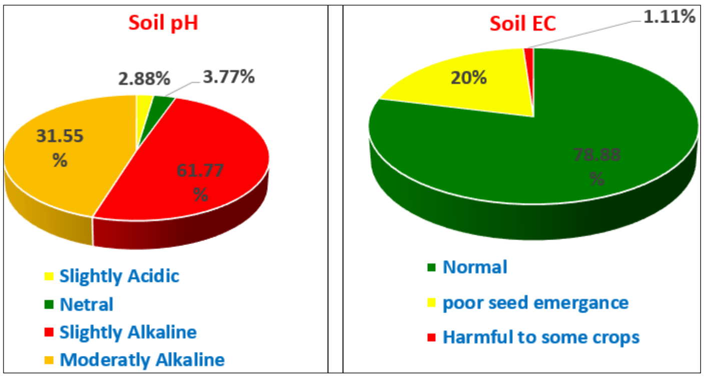

Fig 3: pH and Electrical Conductivity (dSm-1) status of Jalgaon district

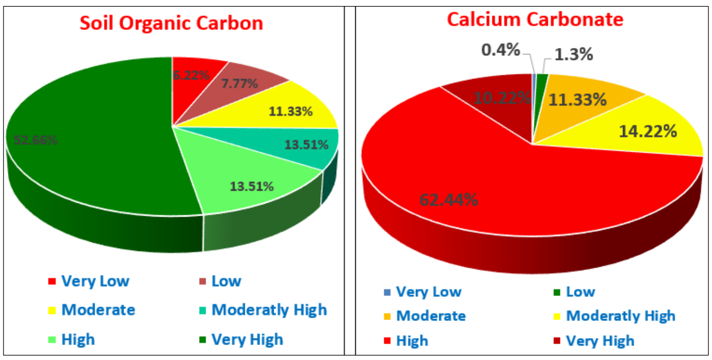

Fig 4: Organic Carbon (g kg^{-1}) and CaCO3 (%) status of Jalgaon district

Organic carbon

The organic carbon content in soils is presented in Table 2 and depicted in Fig. 3. The organic carbon content ranged from 2.35 to 25.80 g $kg^{-1}$with a mean of 11.11 g kg^{-1}. Out of the total soil samples, 28 soil samples (6.22%) were in very low organic carbon content; 35 soil samples (7.77%) were in low organic carbon content; 51 soil samples (11.33%) in the moderate category, 38 samples (8.44%) in moderately high and 61 soil samples (13.51%) in the high category, 237 soil samples (52.66%) in the very high category. However, it was also noted very high variability in organic carbon content among the fields surveyed.

High variability (low to high) in the distribution of organic carbon was reported by Kondvilkar and Thakare (2018) [22] in the adjoining Dhule district (M.S.) study area. Similar observations were also recorded by Ghuge (2002) [12] in Vertisols, Inceptisols and Entisols in the Marathwada region, soils of this area are also formed from basaltic and alluvium lithology under semi-arid climatic conditions, characterized by low precipitation and a high rate of evaporation favouring less accumulation of organic matter.

Calcium carbonate

The data concerning calcium carbonate status are presented in Table 2 and depicted in Fig. 3. The calcium carbonates in the soils of Jalgaon ranged from 1.25-184.76 g kg^{-1} with an average content of 66.06 g kg^{-1}. Out of a total of 450 soil samples, merely 2 samples (0.4%) belonged to a very low category, 6 samples (1.3%) in the low category, 51 samples (11.33%) in the moderate category, 64 samples (14.22%) as moderately high, 281 samples (62.44%) as high and 46 samples (10.22%) were in very high category of calcium carbonate. Similar variability for $CaCO_3$ in soils of Shevgaon tehsil of Ahmednagar district was reported by Medhe *et al*., (2012) [31] and by Nalwade and Pawale (2014) [34] in soils of ARS farm, MPKV, Rahuri.

The calcareousness of soils is a common feature in soils of arid and semiarid climates particularly in Vertisols (black soils) due to precipitation of carbonates and bicarbonates under water stress. Soils from the area are formed from basaltic lithology under semi-arid climatic conditions, characterized by low precipitation and a high rate of evaporation favouring more precipitation and accumulation of $CaCO_3$. Kondvilkar *et al*., (2017) [23] reported such accumulation of calcium carbonates in soils of Sakri tehsil, Dhule district (M.S.), and similar findings were also observed by Golhar and Chaudhari (2013) [13] in Chalisgaon tehsil of Jalgaon district and Hadole *et al*., (2019) [14] in 15 tehsils of Jalgaon district of Maharashtra, and Katkar[b] *et al*., (2013) [21] in Washim and Wardha district (M.S.).

Soil available micronutrient status of Jalgaon district

Table 3: Soil available micronutrient status of Jalgaon district.

Particular	Available micronutrients (mg kg^{-1})			
	Fe	Zn	Mn	Cu
Mean	2.72	0.57	25.42	1.88
Range	0.12-85.4	0.02-3.67	0.11-164.80	0.10-10.10
Critical limit	4.5	0.6	2.0	0.2
Very low	311 (69.11)	105 (23.33)	63 (14)	0 (0.00)
Low	70 (14.22)	191 (42.44)	90 (20)	37 (8.22)
Moderate	42 (9.33)	139 (30.88)	24 (5.33)	41 (9.11)
Moderately high	25 (5.55)	10 (2.22)	13 (2.88)	99 (22)
High	1 (0.2)	3 (0.6)	39 (8.66)	29 (6.44)
Very high	1 (0.2)	2 (0.4)	221 (49.11)	244 (54.22)
Sufficient	69 (15.33)	154 (44.22)	297 (66)	413 (91.77)
Deficient	381 (84.66)	296 (65.77)	153 (34)	37 (8.22)

(Total number of soil samples analyzed-450, Figures in parenthesis expressed in percent

Available Iron

The data about available iron status are presented in Table 3 and depicted in Fig. 7. The available iron in soils ranged between 0.12 to 85.4 mg kg^{-1} with an average of 2.72 mg kg^{-1}. It is inferred from the results that 311 soil samples (69.11%) were found in very low, 70 samples (14.22%) were found in low, 42 samples (9.33%) were found in moderate and 25 samples (5.55%) were found in moderately high, 1sample (0.2%) were found in high and 1 sample (0.2%) in very high iron content category. Out of the total soil samples, 84.66 per cent were deficient and 15.33 per cent were sufficient in available iron. The deficiency of iron in this area might be due to the high pH in soils Dhage *et al*., (2000) [10], Balpande *et al*., (2007) [6] and Ravikumar *et al*., (2007) [42], (Singh *et al*., 2013) [43]. Similar results were reported by Mandavgade *et al*., (2015) [9]. Another reason for the deficiency of iron might be increased removal of micronutrients as a consequence of the adoption of high yielding varieties and intensive cropping together with a shift towards the use of high analysis NPK fertilizers which might have caused a decline in the level of micronutrients in the soil below the critical level which is required for normal productivity of crops (Zende, 1984 and Hadole *et al*., 2019) [54, 14].

Available Zinc

The data about available zinc content are presented in Table 3 and depicted in Fig. 7. The available zinc in soils ranged from 0.02 to 3.67 mg kg^{-1} with an average of 0.57 mg kg^{-1}. Out of total soil samples collected from Jalgaon district, 105 soil samples (23.33%) were categorized in the very low category, 191 samples (42.44%) categorized in the low category, 139 samples (30.88%) categorized in the moderate category, 10 samples (2.22%) in the moderately high category, 3 samples (0.6%) in high category whereas 2 samples (0.4 per cent) in the very high category. The results showed that 65.77 per cent of soils were deficient and 44.22 per cent of soils were sufficient in zinc. The deficiency of available zinc might be due to low organic matter content in the soil, which acts as a natural chelating agent, washout of the upper soil surface and excess pH in the soil. Similar results were also reported by (Minakshi *et al*., 2005) [32], Nagendran and Angayarkanni (2010) [33], Katkar and Patil (2010) [20] and Kumar *et al*., (2014) [24]. Data indicated that the majority of soils were deficient in Zn status; it might be due to alkaline soil reaction

(Kondvilkar *et al.*, 2017 [23]; Golhar and Chaudhari (2013). Similar results were reported by Mandavgade *et al.*, (2015) [13] and Dhage *et al.*, (2000) [10] in soils of adjoining areas study area.

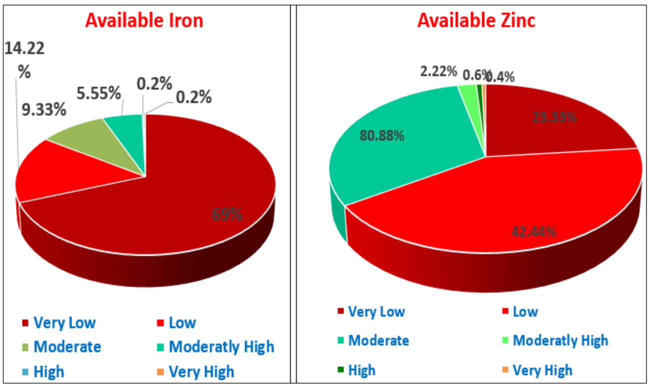

Fig 5: Pie chart showing available iron and available zinc status of Jalgaon district

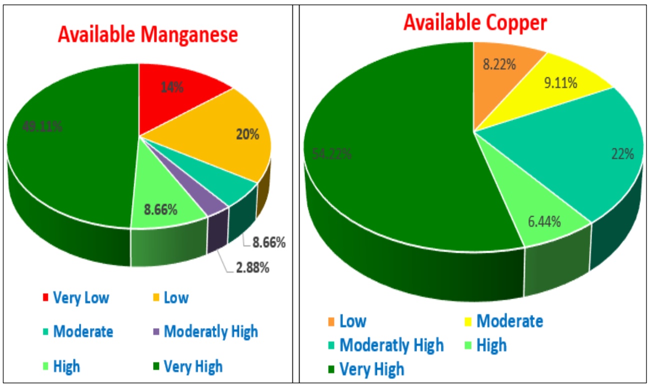

Fig 6: Pie chart showing available manganese and available copper status of Jalgaon district

Available Manganese

The data about available manganese status are presented in Table 3 and depicted in Fig. 8. The available iron in soils ranged between 0.11 to 164.80 mg kg^{-1} with an average of 25.42 mg kg^{-1}. It is inferred from the results that 63 soil samples (14%) were found in very low, 90 samples (20%) were found in low, 24 samples (5.33%) were found in moderate, 13 samples (2.88%) were found in moderately high, 39 samples (8.66%) were found in high and 211 samples (49.11%) in very high manganese content category. Out of the total soil samples, 34 per cent were deficient and 66 per cent were sufficient in available manganese. The sufficiency of available Mn might be due to high organic matter content under optimum soil reaction. Also, the content of NPK influences the availability of Mn in soil (Singh and Rathore, 2013) [43]. Similar observations were also reported by Pandey *et al.*, (2013) [37], Patil (2010) [39] and Singh *et al.*, (2013) [43].

Available Copper

The data about available copper are presented in Table 3 and depicted in Fig. 8. The available copper in soils varied from 0.10 to10.10 mg kg^{-1} with an average value of 1.88 mg kg^{-1}. The majority of the samples i.e. 244 soil samples (54.22%) belong to the very high category of available copper, 29 samples (6.44%) to a high category and 99 samples (22%) were to a moderately high category, 41 samples (9.11%) showed moderate and 37 samples (8.22%) to belonged to a low category of available copper content. In nutshell out of the total soil samples, 91.77 per cent were sufficient and 8.22 per cent were deficient in available copper. Data indicated that the majority of soil samples of the Jalgaon district were sufficient in copper content. The data indicated the sufficiency of Cu in soils might be due to the interactive effect of soil properties like pH, EC and OC which have a managing role in the availability of Cu. It increases with an increase in organic matter but decreases with an increase in pH and $CaCO_3$ content of soil (Mahashabde and Patel, 2012) [27]. Similar results were also observed by Venkatesh *et al.*, (2003) [53], Ravikumar *et al.*, (2007) [42], Pulakeshi *et al.*, (2012) [41] and Gore *et al.*, (2017) [56].

Relationship of Soil Characteristics and nutrient status

Table 4: Correlation of soil properties with available nutrients

Chemical properties Available nutrients	pH	EC	OC	$CaCO_3$
N	0.054	-0.024	0.123	-0.025
P	-0.059	0.033	-0.017	0.019
K	0.101	0.275	0.003	0.014
S	-0.035	-0.213	0.108	0.100
Fe	-0.011	-0.043	-0.024	-0.013
Zn	-0.092	-0.021	-0.053	-0.012
Mn	-0.010	0.283	-0.001	0.002
Cu	-0.002	0.224	0.001	-0.026

Total number of Sample – 450

Correlation of soil pH with available nutrients

The correlations of soil pH with available nutrients are presented in Table 4. The soil pH was negatively and non-significantly correlated with Fe (r=-0.011), Mn (r=-0.010), Zn (r=-0.092) and Cu (r=-0.002).Similar results were also observed by Waikar *et al.*, (2014) [48] that pH was non-significant negative correlated with Cu. A negative and significant correlation between soil pH with Zn was also found by Katkar[b] *et al.*, (2013) [21] and Ali and Lakhan (2013) [2]. A similar result was observed by Jagtap *et al.*, (2019) [16] adjoining area of Dhule district (Maharashtra).The soil pH and contents of $CaCO_3$ were positively correlated (r=0.297**). These results are confirmatory with studies conducted by Thangasamy *et al.*, (2005) [47]. The contents of available Fe decreased significantly with rising in pH and contents of $CaCO_3$. The DTPA-Zn showed negative and significant correlation with $CaCO_3$ (r= -0.228*). Similar results were reported by Katkar[b] *et al.*, (2013) [21]. The negative correlation of available Zn with soil pH (r =-0.089) may be influenced by hydroxides and carbonates consequently making them immobile and unavailable to the plants (Shinde, 2007) [45].

Correlation of electrical conductivity with available nutrients

The correlations of EC with available nutrients are presented in Table 4. The EC of the soil was highly significantly and positively correlated with Mn (r=0.283) and Cu (r=0.224). The EC was negatively non-significantly correlated with Fe (r=-0.043) and Zn (r=-0.224). The positive correlation of EC with available Cu was also confirmed by Mustafa (2013). A negative and non-significant correlation of soil EC with available Fe, Mn, Zn and Cu was also observed by Jagtap, *et al.*, (2019) [16].

Correlation of organic carbon with available nutrients

The correlations of organic carbon with available nutrients are presented in Table 4. Organic carbon was significantly as well as non-significantly correlated with macro and micronutrients. The organic carbon showed positive and non-significant correlations with Cu (0.001) and non-significant and negative correlations with available Fe (-0.024), Zn (r= -0.053), and highly non-significant negative correlation with available Mn (r=-0.001).Organic carbon was non-significantly and positively correlated with available Mn which was also reported by Kondvilkar *et al*., (2017) [23] who assessed the available nutrients status of soils of Sakri tehsil, Dhule district by GIS technique and studied their relationship with chemical properties. Organic carbon was non-significantly and positively correlated with available Mn. Organic carbon showed a non-significant and negative correlation with Fe and Cu while, non-significantly and positively correlated with available Mn and Zn which was also observed by Jagtap, *et al.*, (2019) [16] in adjoin district Dhule. Organic carbon however non-significantly correlated with all properties and DTPA extracted micronutrients except that DTPA-Cu (r=0.256*), where there exists a significant and positive correlation with organic carbon. The relation between pH and $CaCO_3$ was positively correlated which is in line with the findings of Magare, *et al.,* (2019) [26] and Thangasamy *et al.*, (2005) [47]. Magare *et al.,* (2019) [26s], observed a positive correlation with organic carbon (r = 0.019). This could be due to the presence of organic matter which accelerates the released Zn from the parent material and raise their solubility. The identical findings were also stated by Sharma *et al.*, (2003). Soil pH was significantly and negatively correlated with DTPA- Cu and S (r=-0.337**) and (r=- 0.236*), respectively. This might be due to the formation of soluble complexes of organic carbon with micronutrients which subsequently become available to plants.

Correlation of $CaCO_3$ with available nutrients

The correlations between $CaCO_3$ with available nutrients are presented in Table 4. The value of $CaCO_3$ showed a positive and significant correlation with Mn (0.002). The correlation of $CaCO_3$ is found negative and non-significant with available Fe (-0.013) and Zn (-0.012) and Cu (-0.026). Calcium carbonate play role in regulating Zn and Cu accessibility in the soil as is evidenced by the highest correlation coefficient of $CaCO_3$ and DTPA-Zn and Cu. Mali and Syed Ismile (2002) recorded that there was a non-significant correlation between available Cu and $CaCO_3$ in salt-affected soils. Minakshi *et al*., (2005) [32] studied the spatial distribution of micronutrients in soils of the Patiala district and reported that $CaCO_3$ had shown a positive correlation with Mn, and Cu while, negatively with Fe, Zn. Calcium carbonate in the Jalgaon district showed a non-significant and negative correlation with available Fe which was also confirmed by Kondvilkar *et al*., (2017) [23] who assessed the available nutrients status of soils of adjoining areas of the Dhule district. Jagtap *et al.*, (2019) [16] also observed that calcium carbonate was significantly negatively correlated with available Fe, but Calcium carbonate showed a non-significant negative correlation with available Zn and Cu and a positive non-significant correlation with Mn.

Conclusion

From the study, it can be concluded that, soils of Jalgaon district are have wide variation in chemical nature and nutrient status, it is because of rainfall variation, temperature, natural vegetation, parent material and agricultural management practices of soil.

References

1. Adhikari T, Patel KP. Molybdenum status in selected benchmark soil India and its relationship with soil properties, Journal of the Indian Society of Soil Science. 2013;61(3):253-257.
2. Ali J, Lakhan R. Micronutrient status of alluvial soils and their relationship with soil characteristics, Annals of Plant and Soil Research. 2013;15(1):79-80.
3. Alison LE, Moodie CD. In black C. An (ed.) Methods of Soil Analysis Part-Madison, Wisconsin, UAS; c1965. p. 1387-1388.
4. Adhikari T, Patel KP. Molybdenum status in selected benchmark soil India and its relationship with soil properties, Journal of the Indian Society of Soil Science. 2013;61(3):253-257.
5. Binita NK, Dasog GS, Patil PL. Soil fertility mapping in Ghataprabha left bank canal command area of north Karnataka by geographic information system technique, Karnataka Journal Agricultural Science. 2009;22(1):73-76.
6. Balpande HS, Challa O, Prasad J. Characterization and classification of grape growing soils in Nasik district, Maharashtra, Journal Indian Society of Soil Science. 2007;55(1):80-83.
7. Chaudhari RD, Kadu P. Assessment of fertility status of the soils of Dhule tahsil of Dhule district, Paper presented in state-level seminar on soil health enhancement for food and environmental security., organized by PCISSS, at Marathwada Agriculture University Parbhani; c2007. p. 2.
8. Chaudhari PR, Ahire DV, Ahire VD. Correlation between Physico-chemical properties and available nutrients in sandy loam soils of Haridwar, Journal Chemical Biological Physical Science. 2012;2(3):1493-1500.
9. Deshmukh KK. Studies on chemical characteristics and classification of soils from Sangamner area, Ahmednagar District, Maharashtra, India, Rasayan Journal of Chemistry. 2012;5 (1):74-85.
10. Dhage AR, Mane SR, Adsule RN. Available micronutrients in the soils of Shevgaon tehsil (Ahemadnagar Dist.) Concerning soil characteristics, Journal Maharashtra Agricultural University. 2000;25(1):97-98.
11. Gajbe MV, Londe MG, Varade SB. Soils of Marathwada, Journal Maharashtra Agric. Univ. 1976;1 (2-6):55-59.
12. Ghuge SD. Fertility Status of Sugarcane Growing Soils Under Balaghat Shetkari Co-operative Sugar Factory Ujana, M.Sc. (Agri) thesis, Marathwada Agriculture University, Parbhani. (M. S.) India; c2002.
13. Golhar Nima P, Chaudhari PR. Level of significance of various physical and chemical parameters of soils through Electrical Conductivity, Journal of Chemical, Biological and Physical Science. 2013;3(3):2051-2057.
14. Hadole SS, Sarap SR, Lakhe DT, Parmar JN. Status of Micronutrients in Soils of Jalgaon District, Maharashtra, India, International Journal of Current Microbiology and Applied Science. 2019;8(07):1432-1439.
15. Jackson ML. Soil Chemical Analysis, Prentice-Hall India. Pvt. Ltd. New Delhi; c1973. p. 498.
16. Jagtap MM, Chaudhari RD, Thakare RS, Patil TD. Mapping of soil micronutrient status based on GPS-GIS

and biological properties of Ajang village of Dhule tehsil of Dhule district Maharashtra, Journal Pharmacogn Phytochem. 2019;7(5):3270-3275.
17. Jibhakate SB, Bhende SN, Kharche VK, Selvalakshmi V. Physico-chemical status of soils of Katol tehsil in Nagpur district, Journal Soils and Crops. 2009;19(1):122-128.
18. Kadao SH, Prasad J, Gajbhiye KS. Characterization and classification of some typical banana-growing soils of Wardha District of Maharashtra, Agropedology. 2003;3:28-34.
19. Kamble PN, Kurhe AR, Pondhe GM, Gaikwad VB, Baath E. Soil nutrient analysis and their relationship with special reference to pH in Pravaranagar area, district Ahmednagar, Maharashtra, India, International Journal of Scientific and Technology Research. 2013;2(3):216-218.
20. Katkar RN, Patil DB. Available micro nutriment content in soils of Vidarbha. Souvenir of State Level Seminar in Dept. of Soil Science and Agriculture Chemistry, Dr PDKV, Akola organized during; c2010. Jan. 2-3 p. 161-166.
21. Katkar[b] RN, Lakhe SR, Kharche VK, Laharia GS, Sadavarte SG, Chaudhari RD. *et al*. Micronutrient mapping in soils of Wardha district, Maharashtra, J Agropedology. 2013;23(2):113-117.
22. Kondvilkar NB, Thakare RS. Mapping of soil macro and secondary nutrients by GIS in Sakri Tehsil of Dhule district (M.S.), Journal of Pharmacognosy and Phytochemistry. 2018;7(4):3158-3163.
23. Kondvilkar NB, Thakare RS, Aannapurna MVVI. Level of significance of various chemical properties of soils in Sakri Tahsil of Dhule District, (M.S.), International Journal of chemical studies. 2017;5(5):60-67.
24. Kumar A, Mishra VN, Arivastav LK, Banwasi R. "Evaluation of soil fertility status of available major nutrient (N, P&K) and micronutrient (Fe, Mn, Cu & Zn) in Vertisol of Kabeerdham district of Chhattisgarh India", International Journal of Interdisciplinary and Multidisciplinary Studies. (IJAMS). 2014;1(10):72-79.
25. Lindsay WL, Norvell WA. Development of DTPA soil test of Zn, Fe, Mn, and Cu. Soil Science Society of American Journal. 1978;42:421-428.
26. Magare PN, Tedia K, Katkar RN, Lakhera ML, Srivastava GK, Bajpai RK, *et al*. Assessment of chemical properties, micro and secondary nutrients status in agro-ecological-sub region 6.2 a (K4Dd4) Nandurbar district of Maharashtra (M.S), International Journal of Chemical Studies. 2019;7(5):2767-2773.
27. Mahashabde Jyoti P, Patel S. DTPA - Extractable micronutrients and fertility status of soil in Shirpur Tehsil Region, International Journal of Chemical Technology Research. 2012;4(4):1681-1685.
28. Mali CV SyedIsmile. Characterization and fertility status of Marathwada soils, sulphur and micronutrients in soil resource inventory of Marathwada, Department of Agricultural Chemistry and Soil Science, MAU, Parbhani; c2002. p. 72-87.
29. Mandavgade RR, Waikar SL, Dhamak AL, Patil VD. Evaluation of micronutrient status of soils and their relation with some chemical properties of soils of northern tahsils (Jintur, Selu and Pathri) of Parbhani district, IOSR Journal Agricultural and Veterinary Science. 2015;8(2):38-41.
30. Malewar GU. Two decades of soils science research at Marathwada Agril. University, Parbhani. In souvenir (2 Decades of soil science research). Published by Parbhani chapter of ISSS, M.A.U., Parbhani; c1994. p. 17-52.
31. Medhe SR, Takankha VG, Salve AN. Correlation of chemical properties, secondary nutrients and micronutrient anions from the soil of Chakur tahasil of Latur district, Maharashtra, Trends in Life Sciences, an International Peer Reviewed Journal. 2012;1(2):34-40.
32. Minakshi Tur NS, Nayyarl VK, Sharma PK, Sood AK. Spatial distribution of micronutrients in soils of Patiala district - A GIS approach, Journal Indian Society Soil Science. 2005;53(3):324-329.
33. Nagendran A, Angayarkanni A. Vertical distribution of DTPA-extractable micronutrients in soils of Cumbum valley, Tamil Nadu, Agricultural Science. Digest. 2010;30(2):79-84.
34. Nalawade AS, Palwe CR. Assessment of GIS-GPS based soil fertility map of Agriculture Research Station, Savalevihir Farm, M.P.K.V., Rahuri, and Maharashtra, Bio in folet. 2014;11(2A):300-301.
35. Nelson DW, Sommer LE. Total carbon and organic matter. In methods of soil analysis part-II. page, A.L. (Ed.). Agronomy monograph no.9 American society of agronomy, Madison, Wisconsin; c1982. p. 185-187.
36. Padole VR, Mahajan SB. Status and release behaviour of potassium in Swell-Shrink soils of Vidarbha, Maharashtra, Advance Journal Maharashtra Agricultural University. 2003;28(1):3-7.
37. Pandey A, Tiwari LRJ, Sharma RP. Distribution of available macro and micronutrients in soils of Dewas district of Madhya Pradesh, A Journal of Multidisciplinary Advance Research. 2013;2(2):108-114.
38. Panse VG, Sukhatme PV. Statistical Method of Agricultural Workers. ICAR New Delhi; c1985. p. 143-147.
39. Patil R, Mukhopadhyay D. Forms of soil acidity and the distribution of DTPA extractable micronutrient in some soils of West Bengal (India), 19[th] world congress of soil science, Brisbane, Australia, 1-6Aug; c2010. p. 458-460.
40. Patil YM, Sonar KR. Status of major and micronutrients of swell-shrink soils of Maharashtra, Journal Maharashtra Agriculture University. 1994;19(2):169-172.
41. Pulakeshi HBP, Patil PL, Dasog GS, Radder BM, Bidari BI, Mansur CP. Mapping of nutrients status by the geographic information system (GIS) in Mantagani village under northern transition zone of Karnataka, Karnataka Journal Agriculture Science. 2012;25(3):332-335.
42. Ravikumar MA, Patil PL, Dasog GS. Mapping of nutrients status under 48A distributaries in Malaprabha right bank command of Karnataka by geographic information system Technique-I: Major-nutrients, Karnataka Journal Agriculture Science. 2007;20(4):735-737.
43. Singh DP, Rathore MS. Available nutrients status and their relationship with soil properties of Aravalli mountain ranges and Malwa Plateau of Pratapgarh, Rajasthan, India, African Journal Agriculture Research. 2013;8(41):5096-5103.
44. Shinde LV, Phalke GB. Chemical composition of soil from Godavari basin of Beed (M.S.) India, Bioscience Discovery. 2014;5(1):15-18.
45. Shinde SK. Physico-chemical properties and nutrient availability of soils of Latur and Renapur tahsils of Latur district, M.Sc. (Agri.) Thesis submitted to Marathwada

Agriculture University, Parbhani. (MS) India; c2007.
46. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil, Current Science. 1956;25(8):259-260.
47. Thangasamy A, Naidu MVS, Ramavatharam N, Reddy CR. Characterization, classification and evaluation of soil resources in Sivagiri Micro watershed of Chittoor district in Andhra Pradesh for sustainable land use planning, Journal Indian Society Soil Science. 2005;38(1):11-21.
48. Waikar SL, Malewar GU, More SD. Elemental composition of humic and fulvic acid in soils of Marathwada region of Maharashtra, Journal of Maharashtra agriculture University. 2004;29(2):127-129.
49. Waikar SL, Dhamak AL, Patil VD, Jattakar PR. Assessment of soil properties of central farm-B-block of MKV, Parbhani, Journal of Research Agriculture and Animal Science. 2014;2(10):28-34.
50. Watannade FS, Olsen SR. Test of ascorbic acid methods for phosphorus in water and sodium bicarbonate extract, Soil Science Society of America Journal. 1965;29(6):677-678.
51. Williams CH, Steinbergs A. Soil sulphur fractions as chemical indices of available sulphur in some Australian soils, Crop and Pasture Science. 1959;10(3):340-352.
52. Vijesh[a] VK. Survey Ground Water Information, Jalgaon district Maharashtra 2013. Published by Government of India Ministry of Water Resources Central Ground Water Board; c2013.
53. Venkatesh MS, Majumdar B, Kumar Kailash, Patinas. Status of micronutrient cations under various land-use systems of Meghalaya, Journal of the Indian Society of Soil Science. 2003;51(1):60-64.
54. Zende GK. Fertility Management for Higher Sugar Production. Maharashtra Sugar. 1984;9(4):9-25.
55. Khanna JM, Malone MH, Euler KL, Brady LR. Atromentin. Anticoagulant from Hydnellum diabolus. Journal of pharmaceutical sciences. 1965 Jul;54(7):1016-20.
56. Gore J, Lloyd A, Smith M, Bowe J, Ellis H, Lubans D. Effects of professional development on the quality of teaching: Results from a randomised controlled trial of Quality Teaching Rounds. Teaching and teacher education. 2017 Nov 1;68:99-113.