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Assessment of Physico-chemical Properties and Micronutrient Status of Jalgaon District, Maharashtra States, India

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A B S T R A C T

Before the green revolution, the problem of macro and micro nutrient deficiency was not an impediment in crop production in India due to subsistence farming with local crop varieties with low production potential. After the late sixties, green revolution changed the scenario of Indian agriculture. While aiming to achieve targeted yields, the fertility aspect of soil was ignored which led to many problems related to soil health, along with deficiencies of nutrient elements? Available data suggest annual nutrient gap of N, P and K of about 8 to10 millions tonnes in the Indian agriculture and 3.39 million tonnes in Maharashtra agriculture. Hence, assessment of macro and micronutrients status of Jalgaon district, Maharashtra state was carried out to delineated deficiency-sufficiency level of macronutrients and micronutrients for futuristic land use planning. A survey comprising of 450 farmers from 15 Tahsils of Jalgaon district of Maharashtra was carried out during the year 2019-2020. Representative surface soil samples were collected as per the method suggested by Yadav and Khanna (1965). They were analyzed for soil pH, electrical conductivity, organic carbon content, calcium carbonate content, available macro nutrients viz. N, P, K, S, and micronutrients like Fe, Zn, Cu and Mn . It was evidenced that soil pH of the Jalgaon district varied between 6.79 to 8.85 with an average of 7.74, while electrical conductivity was 0.14 to 2.38 dSm-1. Showing slightly acidic to alkaline and most of the soils are safe in total soluble salt content. Organic carbon content was very low to very high and soils are non calcareous to highly calcareous in nature. All soils found to be deficient in available nitrogen. The phosphorus was low to medium, however wide spread deficiency of P is noticed. The soils are rich in potassium and sulfur. Available Iron and zinc content was low to medium while copper and manganese content was sufficient. The data further suggest that soils are becoming saline and sodic in some part of Jalgaon district. The area of phosphorus and zinc deficiency is increasing. The lime induced iron chlorosis is becoming serious problem in irrigated and highly calcareous soil.

Introduction

Soil is one of the most precious natural resource, which provides a medium for plant growth to meet our food and fiber need. Soil filter water, decomposes waste, stores heat and exchanges gases and hence have great bearing on environmental balance. Formation

of 1 cm top soil layer requires 100-400 years. Past decades witnessed a considerable shrinkage in the soil due to unscrupulous increase in the urbanization and industrialization. Agricultural technologies that led to Green revolution resulting in the degradation of this precious natural resource owing to over exploitation under intensive irrigation and cultivation with mismanagement. Due to this, soil has reached a stage of fatigue resulting in the decline in the productivity.

Plant nutrients deficiencies resulted into low production. Available nitrogen, phosphorous, potassium, sulfur, iron, manganese, copper and zinc play a vital role in life cycle of plant and for maintenance of soil fertility and productivity of a soil. Crop production under intensive cultivation without replenishment of soil nutrients mined in large amount led to negative nutrient balances in soil (Patil *et al.*, 2001). Decrease in soil fertility and imbalanced nutrient supply is one of the important factors responsible for stagnation or decrease in crop yields over the years.

The assessment of soil fertility status by soil analysis is an important aspect for sustained crop production. Depending on the nature and characteristics, soil behaves differently. Since, soil is most valuable supporting natural resource for the establishment of any research activity or demonstration, a knowledge about kind of soils as the extent of their distribution is therefore essential for developing land use plan and to carry out educational, sports and other activities. Since soil is very heterogeneous depending on varying soil forming factors and processes, their mapping and characterization becomes imperative for optimizing land use.

Some soils are easy to tilth while others not, some hold high amount of water but is not made available to plants, other holds moderate amount of water but is readily made available to plants.

Materials and Methods

The study area

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 spread on an area of 11,765 km² with population of 4,229,917 (2011 census data). Its headquarters is the city of Jalgaon. 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 the south, Nashik in the southwest, and Dhule in the west. Climatologically Jalgaon District falls in hot semi arid region and receives 77 to 80 cm of rainfall per year (Fig. 1).

The Tapti River flows through Jalgaon from the north. Its total length is 24 Km, of which 208 Km are in Maharashtra. The area is drained by Tapti river and its tributaries in and around the district, including the Aner, Bhuleshwari, Biswa, Chandrabhaga, Dolar, Gadgi, Kapara, Katepurna, Ma, Morans, Nalganga, Nand, Pedhi, Sipana and Wan Rivers.

Experimental

The Jalga on district comprises of 15 tahsils. From each tahsil, five villages were selected and from each village, six farmers were randomly selected during the year 2019-20. So in all total 450 surface soil samples were collected by adopting standard procedure outlined by Yadav and Khanna (1965). The data presented in Table 1 shows the details of soil sample location (latitude and longitude), name of tahsils, number of soil sample taken from each village. During the survey it was observed that most of the farmers were having

small to marginal land holding and rain-fed farming. The Jalgaon district was spread over 20^0 and 21^0 north latitude and $73^0$42' and $76^0$28' east longitude with 225m (738 ft) mean sea level. It is dominated in Entisols (Shallow & eroded soil), Inceptisols soil (Medium deep soils) and Vertisols (deep to very deep soils).

Results and Discussion

Range and average values of soil properties and nutrient status of Jalgaon district

The evaluation soil fertility status carried out determining the soil properties viz. soil pH, EC, OC, and $CaCo_3$ content and available nutrient status viz. nitrogen phosphorus, potassium and sulfur. The results are presented table 2 are interpreted in discussed below.

Soil pH: The data presented in table 2 indicated that soil pH of Jalgaon district varied between 6.79 to 8.85 with are average of 7.74, this shows the soils are tended to have alkaline soil reaction. The alkaline soil pH range in the present survey is because of alkaline basic parent material that is basaltic alluvium. Basaltic alluvium parent material is rich in ferromagnesium minerals. Which on decomposition release basic cations which form salts. Further sub- tropical climate with high evaporation rate with low rainfall keeps there salts and soil profile, which tends to reach upper soil layer in solution by capillary movement.

Table.1 Soil Sampling from 15 Tahsils of Jalgaon District

Sr. No.	Name of Tehshil	Total Villages	Number of samples			Location	
			Model villages under each Tahsils	No of Soil Samples from every villages	No of samples	Latitude	Longitude
1	Amalner	155	5	6	30	21.04901	75.0531
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	20.901903	76.017433
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**		

Table.2 Mean and range values of soil properties of different tahsils of Jalgaon District

Sr, No.	Name of Taluka	No. Of Samples	Soil properties			
			pH	EC (dSm^{-1})	OC ($g\ kg^{-1}$)	$CaCO_3$ ($g\ kg^{-1}$)
1	Muktainagar	30	6.90 - 8.45 (7.73)	0.22 - 2.01 (1.02)	2.35 -18.90 (8.52)	15.60 -155.8 (67.79)
2	Chalisgaon	30	6.90- 8.45 (7.76)	0.41- 2.02 (0.87)	3.21- 15.60 (7.88)	11.30- 184.76 (66.54)
3	Amalner	30	6.89-8.50 (7.79)	0.48-1.95 (1.10)	4.95-22.90 (9.45)	9.67-118.50 (60.52)
4	Jalgaon	30	6.92-8.43 (7.65)	0.42-2.11 (0.91)	4.71-19.90 (10.13)	12.80- 115.20 (66.78)
5	Bhadgaon	30	6.98-8.43 (7.78)	0.32-1.98 (0.64)	7.18-23.80 (14.63)	17.30-111.90 (72.41)
6	Chopda	30	6.99-8.77 (7.79)	0.37-1.45 (0.67)	3.80-19.70 (10.2)	17.50-112.60 (68.43)
7	Yawal	30	7.24-8.77 (7.47)	0.31-2.21 (0.67)	4.80-19.70 (9.39)	12.80-180.90 (68.34)
8	Dharangoan	30	6.89-8.57 (7.44)	0.47-2.38 (1.11)	3.54-21.90 (12.82)	13.30-134.60 (69.34)
9	Erandol	30	6.97-8.30 (7.82)	0.22-0.98 (0.52)	3.74-21.80 (7.84)	11.30-121.10 (69.29)
10	Jamner	30	6.79-8.65 (7.93)	0.36-1.27 (0.67)	3.70-19.90 (10.45)	1.25-112.80 (49.99)
11	Bhusawal	30	6.91-8.44 (7.53)	0.39-2.04 (0.79)	8.90-24.8 (15.22)	12.80-132.80 (68.54)
12	Bodwad	30	7.25-8.71 (7.73)	0.17-1.65 (0.69)	3.24-19.80 (9.58)	7.50-122.30 (64.87)
13	Parola	30	7.33-8.85 (7.98)	0.37-1.65 (0.77)	3.90-21.90 (11.71)	11.60-117.70 (53.09)
14	Pachora	30	7.53-8.41 (7.97)	0.14-1.53 (0.68)	9.70-21.80 (14.94)	10.90-161.80 (71.38)
15	Raver	30	6.99-8.54 (7.79)	0.27-1.32 (0.76)	7.30-25.80 (14.91)	18.10-174.30 (79.62)
Range			**6.79-8.85**	**0.14-2.38**	**2.35-25.80**	**1.25-184.76**
Mean			**7.74**	**0.79**	**11.11**	**66.06**

Fig.1 Jalgaon district map

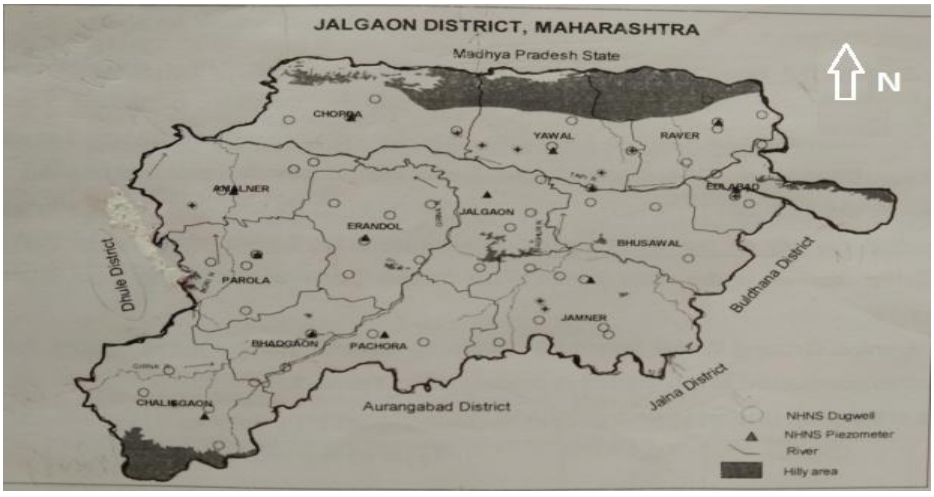

Table.3 Mean and range values of available soil micro nutrients different Tahsils of Jalgaon District

Sr, No.	Name of Taluka	No. Of Samples	Avaialble micronutrients mg kg^{-1}			
			Fe	**Zn**	**Mn**	**Cu**
1	Muktainagar	30	1.00-15.33 (5.06)	0.29-3.4 (1.68)	5.70-143.20 (65.94)	2.05-6.25 (3.75)
2	Chalisgaon	30	0.75-11.49 (3.59)	0.17-1.97 (0.59)	1.91-117.83 (33.71)	0.28-5.74 (2.36)
3	Amalner	30	0.34-14.81 (3.51)	0.08-0.97 (0.40)	12.00-99.00 (38.61)	0.98-3.71 (2.05)
4	Jalgaon	30	0.57-8.15 (2.62)	0.14-1.35 (0.57)	7.90-164.80 (50.35)	1.27-4.77 (2.86)
5	Bhadgaon	30	0.28-3.97 (1.87)	0.22-1.23 (0.79)	0.11-1.98 (1.34)	0.10-0.84 (0.46)
6	Chopda	30	0.17-0.91 (0.52)	0.11-1.10 (0.37)	0.11-2.77 (1.03)	0.11-0.84 (0.38)
7	Yawal	30	0.12-0.91 (0.46)	0.11-083 (0.42)	0.11-2.77 (1.14)	0.11-0.73 (0.30)
8	Dharangoan	30	0.45-12.80 (2.48)	0.02-3.67 (0.57)	9.07-126.90 (51.11)	1.60-10.10 (3.10)
9	Erandol	30	0.21-0.96 (0.53)	0.12-0.98 (0.49)	0.56-2.45 (1.62)	0.22-0.88 (0.51)
10	Jamner	30	0.18-17.67 (2.15)	0.22-1.39 (0.55)	0.11-73.3 (9.29)	0.11-9.11 (1.95)
11	Bhusawal	30	0.21-3.21 (1.48)	0.09-0.93 (0.39)	6.56-80.83 (40.57)	1.00-5.74 (3.30)
12	Bodwad	30	0.89-8.64 (3.82)	0.09-1.92 (0.56)	6.24-72.52 (30.38)	0.49-4.38 (2.62)
13	Parola	30	1.35-9.06 (3.03)	0.23-1.21 (0.59)	4.37-84.7 (30.49)	0.36-5.67 (2.10)
14	Pachora	30	0.80-85.40 (8.48)	0.20-0.98 (0.43)	3.64-88.70 (24.72)	0.85-3.71 (2.02)
15	Raver	30	0.24-6.42 (1.65)	0.18-1.20 (0.62)	0.15-1.84 (1.06)	0.11-1.34 (0.54)
Range			**0.12-85.4**	**0.20-3.4**	**0.11-164.80**	**0.10-10.10**
Mean			**2.72**	**0.54**	**25.42**	**1.88**

Figures in the parenthesis indicates mean values

Electrical conductivity: Total soluble salt concentration is represented by electrical conductivity. The EC value in present study varied between 0.14 to 2.38 dSm^{-1} with an average of 0.79 dSm^{-1}. These in accordance with study conducted by Dhane and Shukla (1995), Durgude (1999). They also observed that the soils EC value were varied between 0.05 to 1.39 dSm^{-1} and 0.46 to 2.45 dSm^{-1} and categorized on safe for crop production. In general soils of Jalgaon district soil taxonomically falls in Entisol or Inceptisol order, with good drainage and hence even with soils are derived from basaltic alluvium, the salt concentration could not reach to the level of crop injury.

Organic carbon: The organic carbon is a back bone of crop production and soil quality. Its content in Jalgaon district was observed between 0.89 to 25.80 g kg^{-1} with average value of 11.11 g kg^{-1}. The soils fall to be very

low to medium in organic carbon content. This might be because of shallow and eroded soil observed in this area. Further Organic Carbon content was low because of high temperature and low moisture content. These two climatic parameters hasten the oxidation of organic carbon present in organic matter in these soils. These results are in accordance with Waikar *et al.,* (2004)

Calcium carbonate: The data on calcium carbonate are reported in table 2 which shows that soils are calcareous to highly calcareous nature Patil *et al.,* (2014) reported that nearly 42 percent soils of Marathwada region are calcareous in nature. This might be due to precipitation and accumulation of calcium and magnesium carbonate due to high evaporation rate observed in that area.

Available micronutrient status of Jalgaon district

Available iron: The data presented in table 3 shows the range and mean value of iron over 15 tahsils of Jalgaon district. It is observed from table 3 that in general Fe availability ranges from 0.12 to 85.4 mg kg^{-1} which shows wide variation in its distribution pattern. The average value suggest that there soils are poorly nourished with available iron.

One of the primary reasons of the low availability is at low pH values the fertility iron is high and as the pH is raised their solubility and availability to plant deceases and become deficient, which was observed in the present study. Further due to high content of calcium carbonate the iron availability get drastically reduced. There type of observation and lime included iron chlorosis are also recorded by many research workers form Maharashtra Dhange *et al.,* (2000), Patil and Meishri (2014), Katkar and Patil (2010), Waiker *et al.,* (2014).

Available zinc: Zinc availability, like that of iron is reduced when soil pH raised. Further presence of free calcium carbonate decrease the zinc availability, because zinc is tightly observed to calcium carbonate crystal surfaces. Both these factors are prevailed in Jalgaon district soil and hence on an average the DTPA extractable zinc observed is just 0.54 mg kg^{-1} its content varied from 0.20 to 3.40 mg kg^{-1} Wide spread zinc deficiency in the soils of Marathwada and Maharashtra was reported by Patil (2014). Further Madavgade *et al.,* (2015) also reported reduced zinc availability due to high calcium carbonate content of soils.

Available manganese: Table indicates the available Manganese content in the soils of Jalgaon district. Its content was varied between 0.10 to 164.80 mg kg^{-1} with mean value of 25.42 mg kg^{-1} It was reported by many researches Shinde (2007), Katkar and Patil (2010), Madavgade *et al.,* (2015) that black soils are well supplied with manganese content, which also observed in the present investigation. Brady and Weil (2015) reported that calcareous natures of soil, high pH, low organic matter are some of the reasons of reduction copper availability.

Available copper: Copper availability in black cotton soils is relatively better as compared to other trace element cations Table 3 shows that DTPA copper content of Jalgaon soils distributed from 0.10 to 10.10 mg kg^{-1}. In few soils DTPA copper content is very low; this was attributed to coarse texture and shallow soils Brady and Weil (2015). The average copper availability in to soils of Jalgaon is noticed to the tune of 1.88 mg $kg^{-1.}$

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