ASSESSMENT OF MACRONUTRIENTS STATUS OF JALGAON DISTRICT, MAHARASHTRA STATE, INDIA.

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ABSTRACT: 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 this 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.

Keywords: Acidic Soil, Alkaline Soil, Calcareousness, Macro and Micro Nutrients, Soil Salinity, Iron Chlorosis, Soil fertility, Soil Health, Soil Productivity.

1. 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. Dependingon 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.

Assessment of soil fertility status by soil analysis is important aspect for sustained crop production. Depending on the nature and characteristic soil behave differently. 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.

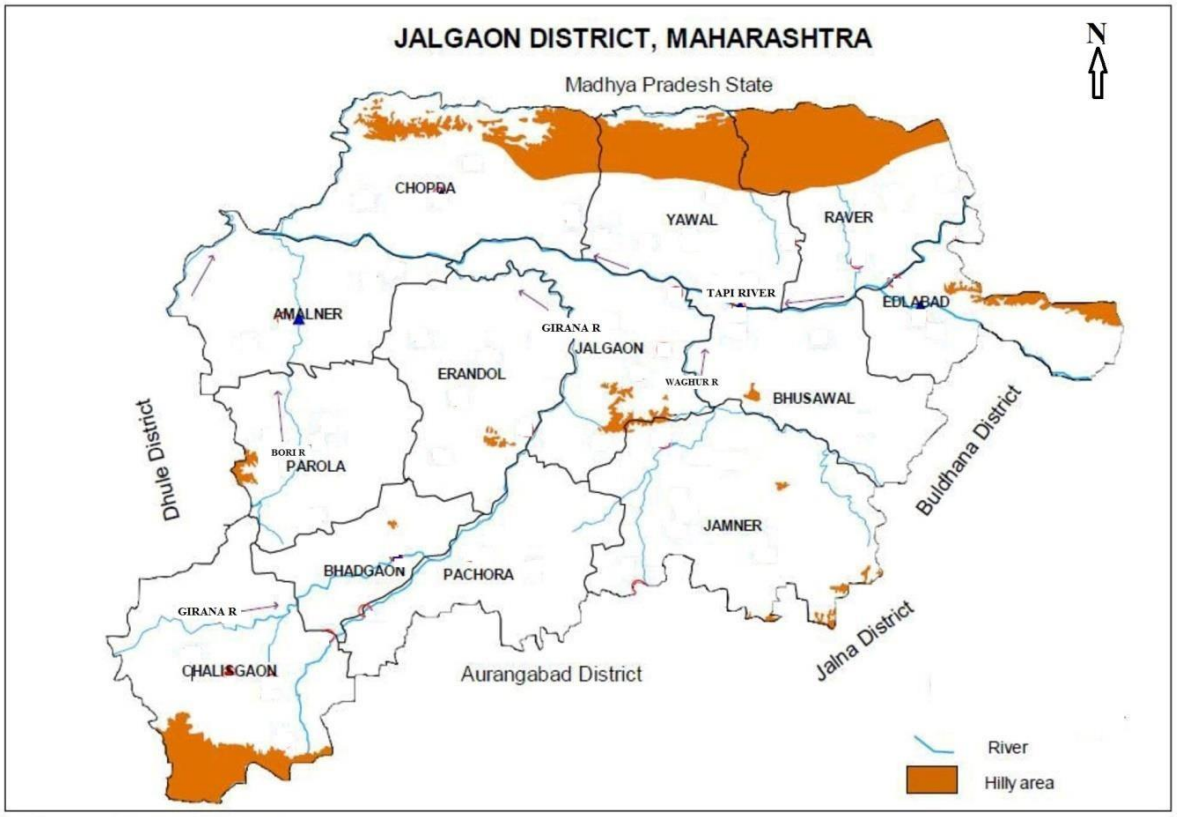

Fig. 1 Jalgaon district map

2. 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 77to80 cm of rainfall per year. 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 .

3.EXPERIMENTAL

The Jalgaon 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$15' and $21^0$30' N latitude and $74^0$55' and $76^0$25' E longitude with total area of 1,16 million ha and 225m (738 ft) mean sea level . It is dominated in Entisols (Shallow & eroded soil) , Inceptisols soil (Medium deep soils) and Vertisols (deep tovery deep soils).

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**		

4.RESULTS AND DISCUSSION

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

The tahsil wise data in respect of range average values of Jalgaon district are presented in Table 2. It is evidenced that soil pH of Jalgoan district varied from 6.79 to 8.85 with an average of 7.74 , which indicates soils are slightly acidic to highly alkaline in reaction . However the average pH suggest that soils are tending towards alkalinity. The tahsils wise soil reaction data also showed similar trend Yawal and Dharangaon tahsil soils showed relatively lower alkalinity (7.47 and 7.44) compared to other tahsils . While Parola and Pachora tahsils showed higher pH (7.98 and 7.97)

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	0.36-1.27	3.70-19.90	1.25-112.80

			(7.93)	(0.67)	(10.45)	(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**

Soil pH: From this data it was inferred that mostly there soils are normal to alkaline in soil reaction. This was distributed to the basaltic trap present material from which these soil are formed. The higher content of ferromagnesian minerals in basaltic trap material might have resulted in the alkaline soil reaction. Further the Jalgaon district comes under semi-arid tropic, where precipitation is less and evaportarspiration losses are more which contribute towards accumulating of basic salts which favours the higher pH . The tahsil Parola and Pachora received more irrigation which was regulated in to higher pH as compared to other tahsils. These results are in accordance with the observation recorded by Chaudhari and Kadu (2007), Ingleet al (2017) from the region of Marathwada and Khandesh region, These finding support the observation of Padole & Mahajan (2003), Waikar et-al (2005), Chaudhari & Kadu (2007) Jibhakate et al (2009), Desmukh (2012), Shinde et al (2014) as they reported that the black cotton, soils of Marathwada , Vidharbh and Khandesh region of Maharashtra are derived from basaltic parent material which content higher ferroganesium minerals and less sillica content .

Electrical Conductivity : Table 2 shows the data on electrical conductivity of Jalgaon district, it was ranged from 0.14 $dsm^{-1}$to 2.38 dsm^{-1} with an average of 0.79 dsm^{-1}. It was ability that basaltic parent material which is rich in basic cations Ca, Mg, Na, K adds salts of there cations. It is noticed that as low as 0.14 dsm^{-1} electrical conductivity is noticed in tahsil Pachora while maximum EC i.e. 2.38 $dsm^{-1}$was recorded in Dharangaon tahsil. The average electrical conductivity 0.79 dSm^{-1} shows that this soils are on the boundary line of total soluble salt connection, as on today the EC is safe for crop production but if due care (soil as water conservation and utilization) is not taken it may become injurious to most of the crops. As discussed in earlier paragraphs it was viewed that soil under command area showed high EC as compared to non-common area. Many researches from this regions and from other regions of Maharashtra emphasized that non- judicious use of water resulted black cotton soils in to high total soluble salt concentration. The similar observation is also recorded in that study.

Organic Carbon :Organic Carbon content of soil is backbone of soil productivity and many functions by which soil fertility and productivity is enhanced. The tahsils of Jalgaon district found to be well fed with organic carbon content. In some soils its content is far below the minimum content while most of the soils content medium to high organic carbon content. It was seen that as low as 2.35 g kg^{-1} organic carbon content was noticed in Mukatainagar tahsil, while Raver tahsil soil showed highest organic carbon content to the tune of 25.80 g kg^{-1}. The average organic carbon content was 11.11 g kg^{-1} which found to be sufficient. However, it was also noted that there was very high variability in organic carbon content among the fields surveyed. The lower content of organic carbon content was noted in shallow and degraded land surfaces. While the higher organic carbon content was noticed under irrigated soils and medium to deep black soils. The higher organic carbon content of this soils can be attributed to cultivation of crops in kharif, rabi and summer season. It was observed in world's oldest experiment of Rotham state that cropping increase the organic carbon content over a period of time. But long term experiments conducted at Parbhani and many other locations are also recorded higher organic area over no cropped area or single season crop. The important in organic carbon content in cropped area might be due the addition of litter and roots of crops to the soil. In present study similar observation was recorded to the surface.

Calcium Carbonate : In Maharashtra nearly 42 present soils are calcareous in nature. In present study the data showed that average calcium carbonate content of these soils form to be 66.06 g kg^{-1}, which shows calcareousness. An soils from 15 tahsilsof Jalgaon showed same quality of calcium carbonate, no soil is from to be without calcium carbonate content . The calcium carbonate content was ranged from 1.25 g kg to 184.76 g kg^{-1} ; with an average of 66.06 g kg^{-1}. The calcareousness of their soilsattribute to the subtropical climate and mineralogy of basaltic parent material. Calcium containing minerals like plagioclase on weathering releases calcium but due to insufficient precipitation (rainfall) it is not washed away from soil profile, rather it get accumulated in subsoil. This accumulated calcium carbonate are reached through capillaries water movement to the surface. Further due to deep plouging during soil cultivation, the surface calcium carbonate comes to surface . The calcareous nature of black soils of Maharashtra was reported by Dhage et al (2000), Mali and Raut (2001), Gabhane et al (2006), Medhe et al (2012)

5. Available macronutrient status of Jalgaon district.

In the present investigation the tahsil wise soils samples were analyzed for available nutrient status, The data recorded are presented in table 3 shows the nutrient studied were nitrogen , phosphorus, potassium, and sulfur.

Available Nitrogen :The data showed that availability of nitrogen in Jalgaon district was varied between 88.68 $kgha^{-1}$. (Low) to 524.00 $kgha^{-1}$ (high). The average availability of nitrogen in the soils was to the content of 210.76 $kgha^{-1}$. The lowest available nitrogen content was recorded in Erandol tahsil while highest available nitrogen content was seen in Bhusawal tahsil. The average nitrogen content 210.76 $kgha^{-1}$ shows the soils are medium in nitrogen availability. This might be because of relatively higher content of organic carbon content. Patil (2014) observed that the nearly 98 percent nitrogen in there soils comes from the organic matter content of soil. This statement supposed by many researcher.

Table 3 Mean and Range Values of Available soil macro nutrients different tahsils of Jalgaon District.

Sr, No.	Name of Taluka	No. Of Samples	Available Macro nutrients kg ha^{-1}			
			N	P	K	S
1	Muktainagar	30	94.50-352.47 (192.84)	11-87 (32.66)	27-2164 (1031.23)	3.20-15.52 (8.28)
2	Chalisgaon	30	95.20-300.17 (175.71)	22-111 (70.56)	206-1949 (769.23)	2.46-23.92 (10.95)
3	Amalner	30	99.80-360.12 (183.40)	5-65 (31.36)	430-2070 (999.33)	2.19-8.31 (4.60)
4	Jalgaon	30	111.80-371.21 (175.86)	4-86 (26.20)	349-2043 (899.43)	4.21-24.93 (9.26)
5	Bhadgaon	30	156.17-362.13 (230.49)	14.65-46.39 (31.12)	212-392 (313.36)	9.27-36.73 (24.72)
6	Chopda	30	112.14-367.11 (244.75)	18-50 (33.96)	248-402 (329.56)	15.90-34.94 (20.36)
7	Yawal	30	136.80-367.39 (233.05)	16-52 (34)	246-402 (330.80)	13.79-32.03 (20.09)
8	Dharangoan	30	99.98-357.12 (172.69)	9-98 (37.63)	503-1747 (952.93)	5.01-16.35 (9.47)
9	Erandol	30	88.68-275.69 (141.26)	17-32 (25.66)	201-403 (281.36)	9.36-22.24 (16.62)
10	Jamner	30	129.63-372.21 (210.55)	14-162 (39.43)	115-844 (345.33)	1.12-20.60 (13.44)
11	Bhusawal	30	133-524 (287.57)	7-75 (41)	106-2701 (783.33)	2.62-15.76 (9.80)
12	Bodwad	30	121.78-438.47 (266.41)	13-96 (40.66)	245-1465 (919.03)	1.99-19.35 (8.55)
13	Parola	30	99.82-438.25 (213.22)	9-97 (47)	278-1357 (788.46)	1.32-15.38 (8.45)
14	Pachora	30	101.21-429.21 (248.86)	16-111 (56.10)	195-1599 (761.43)	4.95-23.74 (12.47)
15	Raver	30	92.82-301.67 (196.41)	12.21-43.95 (31.11)	190-421 (299)	14.78-37.40 (24.41)
Range			**88.68-524**	**4-162**	**27-2701**	**1.12-37.40**
Mean			**210.76**	**38.56**	**653.58**	**13.43**

Available Phosphorus :Second most important macro nutrient in crop production is phosphorus . Phosphorus act as a energy transformer through ADP and ATP. It is required for all hilly plants and organism . The available content of phosphorous in Jalgaon district was 38.56 $kgha^{-1}$ which can be placed in medium category. However, some soils were very low in available P content and it was noticed in almost all tahsil of Jalgaon as low as 4 $kgha^{-1}$. Available P status was recorded in Jalgaon district similarly Amalner (5 $kgha^{-1}$) , Bhusawal (7 $kgha^{-1}$) followed by Dharangoan, Parola etc. Further all tahsils showed medium to high content of available P. Amongst all highest available P (162.06 $kgha^{-1}$) was noticed in Jasmner tahsil of Jalgaon district. The medium phosphorus availability was also reported by Malewar 1995 in black soil of Maharashtra and in Jalgaon district Pandey et al (2000).

Available Potassium : Table 3 depicts the data on available potassium content in the soils of Jalgaon district. Its content varied from 106 $kgha^{-1}$ to 2701 $kgha^{-1}$. This shows very wide variation in available K content of Jalgaon district. The average content was 653.58 $kgha^{-1}$. This shows that Jalgaon district sufficient in K content. Many research workers from Maharashtra and different parts of India related high status of available K in black soil. In the soils generate from K beginning minerals make up of black soil. The basaltic parent material rich in potash belong mineral. Hence on decomposition K is related soils are sufficient in K content. Which contribute to high K status. Jibhkate et al (2009).

Available Sulfur : The available sulfur content of Jalgaon district was ranged from 1.12 $kgha^{-1}$ to 37.40 $kgha^{-1}$ with an average of 13.43$kgha^{-1}$ · It is evidenced from the data present in table 2 , that all tahsils soils of Jalgaon district except Raver found to be deficient in available sulfur. This shows major constraint in crop production of Jalgaon district. Among all nutrients availability of surfer found to be very low. It is difficult to understand the behavior of S in these soils. So details fractional study of sulfur is more focus with on this. However, Patil and Mali (2001) refused that oil seed growing track of Marathwada emergingas a Sulfur deficient area. They observed nearly 30 present soils of Parbhani and Latur district were sulfur deficient.

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REFERENCES

[1] Aggarwal, V. and Nayyar, V.K. 1998. Available soil sulphur status and sulphur nutrition of wheat crop. J. Indian Soc. Soil Sci. 46 (1): 71-75.

[2] Athokpam, H., Wani, S.H., Kamei, D., Athokpam, H.S., Nongmaithem, J., Kumar, D., Singh, Y.K., Naorem, B.S., Thokchom, R. D. and Lamalakshmi Devi. 2013. Soil macro- and micro- nutrient status of Senapati district, Manipur (India). Afr. J. Agric. Res. 8(39): 4932-4936.

[3] Balpande, H.S., Challa, O. and Prasad, J. 2007. Characterization and classification of grape growing soils in Nasik district, Maharashtra. J. Indian Soc. Soil Sci. 55(1): 80-83.

[4] Bidari, B.I., Math, K.K. and Ninganur, B.T. 2008. Physico-chemical properties and nutrient status of soil profiles producing varying quality chillies in Dharwad, Karnataka. Asian J. Soil Sci. 3(2): 336-342.

[5] Brady N.C & Weil R R, 2015. The nature & properties of soil publish Pearson India Education Services pvt. Ltd. Noida. India PP751.

[6] Chaudhari, R.D. and Kadu, P.P. 2007. 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 Agril. Univ. Parbhani. Oct. 12&13, 2007. pp. 2.

[7] Deshmukh K. K.2012.Studies on chemical characteristics & classification of soils from Sangamner area, Ahmednagar district,Maharashtra,India.Rasayan J,Chem.5(1):74-85.

[8] Devdas, D., Srivastava, L.K. and Verma, U. 2013. Study on correlation between physico-chemical properties of pH, OC and available N, P and K in black soil of Navagarh block under Janjgir district in Chhattisgarh. Asian. J. Soil Sci. 8(2): 381-384.

[9] Gabhane, V.V., Jadhao, V.O. and Nagdeve, M.B. 2006. Land evaluation for land use planning of a micro watershed in Vidarbha region of Maharashtra. J. Indian Soc. Soil Sci. 54(3): 307-315.

[10] Ingale, S.T.Patil, S. N.Kolhe,N.P.Marathe and Kachate N.R.2017.Evaluation of Agricultural soil quality in Khandesh region of Maharashtra, India. NEPT,An International Quarterly Scientific J.17(4):1147-1160.

[11] Jibhakate, S.B., Bhende, S.N., Kharche, V.K. and Selvalakshmi, V. 2009. Physico-chemical status of soils of Katol tehsil in Nagpur district. J. Soils and Crops. 19(1): 122-128.

[12] Kadu, P.P. 2007. A survey of fertility status of soils of Parola tahsil of Jalgaon district. Paper presented in state level seminar on soil health enhancement for food and environmental security, organized by PCISSS, at Marathwada Agril. Univ. Parbhani. Oct. 12 and 13, 2007 Abst. pp. 4.

[13] Padole, V.R. and Mahajan, S.B. 2003. Status and release behavior of potassium in Swell-Shrink

soils of Vidarbha, Maharashtra, J. Maharashtra agric. Univ. 28(1): 3-7.

[14] Pandey, S.P., Singh, R.S. and Mishra, S.K. 2000. Availability of phosphorus and sulphur in Inceptisols of central Uttar Pradesh. J. Indian Soc. Soil Sci. 48(1): 118-121.

[15] Patil ,V.D. and Mali,C. V. 2001.Available sulphur and physico-chemical characteristic of oilseed dominated area of Latur district.JMaharastraagric Univ.,23(2):117-118.

[16] Patil S.P. and Patil T.D. 2007. Fertility status of soils of Sakri tehsil of Dhule district. Paper presented in PCISSS, at Marathwada Agril. Univ. Parbhani. Oct.12 and 13, 2007 Abst. pp. 4.

[17] Patil V.D. 2014. Soil Map of Marathwada Published by Head , Dept. Soil Science and Agril. Chemistry, VNMKV, Parbhani.

[18] Pharande, A.L. and Sonar, K.R. 1996. Depth wise distribution of different forms of potassium in important Vertisols soils series of Maharashtra. J. Potassium Res. 12(2):127-134.

[19] Shinde, S.K. 2007. 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.

[20] Shinde, Y.R., Indulkar, B.S. and Waghmare, M.S. 2014. Soil nutrient index of available N, P and K in soils from Udgir tahsil of Latur district (M.S.). Bulletin of Pure and Appl. Sci. 33 C- Chemistry(1-2): 21-26.

[21] Singh, R.P. and Mishra, S.K. 2012. Available macro nutrients (N, P, K and S) in the soils of Chiraigaon block of district Varanasi (U.P.) in relation to soil characteristics. Indian J. Sci. Res. 3(1): 97-100.

[22] Waikar, S.L., Dhamak, A.L., Patil, V.D. and Jattakar, P.R. 2014. Assessment of soil properties of central farm-B-block of MKV, Parbhani. J. Res. Agric. and Ani. Sci. 2(10): 28-34.

[23] Yadav G S & Khanna S S.1965 : Introductory Course in Soil Science 1965, Publ.