E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(12): 226-231
Received: 06-11-2024
Accepted: 03-12-2024

SV Tupkar
M.Sc. Scholar, Department of Soil Science, College of Agriculture, Latur, Maharashtra, India

AN Puri
Assistant Professor, Department of Soil Science, College of Agriculture, Latur, Maharashtra, India

PH Vaidya
Professor, Department of Soil Science, College of Agriculture, VNMKV Parbhani, Maharashtra, India

VP Suryavanshi
Associate Professor, Department of Agronomy, College of Agriculture, Latur, Maharashtra, India

Corresponding Author:
SV Tupkar
M.Sc. Scholar, Department of Soil Science, College of Agriculture, Latur, Maharashtra, India

Soil resource inventerization of Harangul Village, Latur District, Maharashtra

SV Tupkar, AN Puri, PH Vaidya and VP Suryavanshi

DOI: https://doi.org/10.33545/2618060X.2024.v7.i12Sd.2137

Abstract
The study was aimed at to characterize the soils of the study area by analysing their morphological, physical and chemical properties of the soils. Four sites from various micro topographic levels were selected by using satellite data along with forty surface sample sites adjusting the topography and the soil profiles samples were collected, processed and analyzed for characterization. The soils of Harangul village were very shallow to very deep (0 to 150 cm), black (10YR 3/1) to very pale brown (10YR 7/2) in colour, silty clay loam to clayey in texture, granular to angular blocky in structure. The soils were slightly to moderately alkaline, non-saline, low to moderate in organic carbon content and calcareous in nature. The soils were well fertile.
Taxonomically, these soils were classified into Inceptisols, Entisols and Vertisols and at family level these soils classified as Loamy skeletal, mixed, isohyperthermic, Typic Haplustepts; Loamy skeletal, mixed, isohyperthermic, Typic Ustorthents; Fine clayey, smectitic, isohyperthermic, Calcic Haplusterts; clayey, mixed, isohyperthermic, Lithic Ustorthents. The soils were very low to moderate in available nitrogen and phosphorus, moderate to very high in available potassium and sufficient in available Fe, Mn and Cu and deficient to sufficient in available Zn content.

Keywords: Harangul village, morphological, physical, chemical and soil classification

Introduction
The Village Harangul lies between "18.53`59.99" North Latitude and "76.39`59.99'' East Longitude. Ground water exploration in the village has been taken up in different phases in hard rock areas occupied by Basalt. The soils are mostly black varying in texture from clay to clay-loam. Soils in the study area ranging in depth from 1 to 2 m, are black and rich in plant nutrients. The general elevation of the area ranges from 601 to 638 m above MSL. The majority of the region under the study area is made up of murrum lined shallow soils, while some of these soils are deep to extremely deep and are located in lower topographic positions. Sorghum, cotton, soybean and pigeon pea are the major crops grown in the research region. These crop current yields are significantly lower than their experimental yields. Crops that have been adapted to the climate are grown in the shallow soil highlighted by the murrum layer, and farmers give less consideration to their preservation and upkeep throughout cultivation. Therefore, it is too important to find out the stress inducing factors responsible for low yield and selection of crop should be site specific with the help of sophisticated land use planning.

Materials and Methods
The sampling sites were decided on the basis of landform. To understand the soil variability in the different farms of Harangul village four representative soil profiles as shown in Fig no.1 were collected. Site and soil characteristics like slope, stoniness, erosion, color, texture, structure, soil type shallow to deep etc. were recorded as per Soil Survey Division Staff (2000). Nearly 1.0 kg of representative soil sample from each horizon of all the representative profiles were collected and dried in laboratory at room temperature, grinded using wooden mortar and pestle, screened through 2 mm sieve, properly labeled and stored in polythene bags for laboratory analysis.

The particle size distribution analysis was carried out as per the international pipette method (Jackson, 1979) [8]. The bulk density was determined by clod coating method (Piper, 1966) [14]. (AWC) and (PAWC) was determined at the soil moisture range of 33 kPa and 1500 kPa on pressure plate apparatus using the expression suggested by Gardner *et al*. (1984) [6] and latter modified by Coughlan *et al.,* (1986) [3]. The chemical properties of soils pH and EC was determined 1:2.5 soils: water suspension using pH and conductivity meter as per method described by Jackson (1979) [8]. The calcium carbonate was estimated by rapid titration method as described by Piper (1966) [14]. Modified Walkley and Black's rapid titration procedure was followed for estimating the organic carbon content (Jackson 1958) [10]. CEC was estimated with 1N sodium acetate (pH 8.2), (Richards, 1954) [15]. Exchangeable calcium and magnesium were determined by leaching with 1 N NaCl solution (Piper, 1966) [14] and titrating the leachate with standard EDTA solution as per the method of Richards (1954) [15]. Exchangeable sodium and potassium were determined by leaching soil with 1N ammonium acetate (pH 7.0) solution using flame emission photometer (Jackson, 1958) [10]. Available Nitrogen was determined by alkaline permanganate method by using Kel-plus distillation unit (Subbiah and Asija, 1956) [20]. Available phosphorus was determined by Olsen's method; reading was recorded using spectrophotometer (Jackson, 1967) [9]. Available potassium was determined by flame photometer using 1 N Neutral ammonium acetate (pH 7.0) solution as an extractants described by (Jackson, 1967) [9]. Available sulphur was determined by turbidity method described by Williams and Steinberg (1959) [22]. Available boron was determined as per the standard procedure by Berger and Truog (1939) [1].

Results and Discussion

Morphological Characteristics

Morphological characteristics as given in Table.1 like The soils (P_1) developed on lower topography pediment belonging to the order Inceptisol (638 m MSL) with average depth of 65 cm. These soils were silt clay to clay in texture with medium, moderate, subangular blocky to medium, moderate, angular blocky in structure. The soils (P_3) developed on middle topography pediment belonging to the order Vertisol (601 m MSL) with average depth of 160 cm. These soils were clay in texture with medium, moderate, subangular blocky to medium, weak, granular in structure. The soils (P_2 and P_4) developed on upper topography pediment belonging to the order Entisol (620 - 625m MSL) with average depth of 60cm. These soils were loam to silt clay in texture with medium, moderate, subangular blocky to medium, weak, granular in structure. The soils of the study area were deep black (10YR 3/1) to very pale brown (10YR7/2) in colour. The surface horizons and subsurface horizons had lower bulk density values (1.27 to 1.43 Mg m^{-3}) as compared to murrum (Bw horizon) layer (1.39 to 1.59 Mgm^{-3}). The available water capacity of the soils ranged from 8.1 to 18.2 per cent and plant available water capacity ranged between 90.82 to 306.71 mm. The maximum plant available water content was observed in soils of Vertisol and lowest in Entisol. The data on correlation coefficient between the soil attributes revealed that there was positive correlation between clay with AWC (r=0.507) and cation exchange capacity (r=0.99). This indicated the clay and CEC has been a yield reducing factor due to the shallowness of the soil in the upper pediment.

Physical properties

Physical properties of soils were presented in Table 2 shows that bulk density of study area varied from 1.27 to 1.59 Mg m^{-3}. The particle size distribution i.e. sand, silt and clay content of the study area varied from 4.37 to 20.96, 22.83 to 61.48 and 30.17 to 66.48 percent respectively, the soil developed on lower topographic positions showed higher clay content gradually increased with depth, indicating clay illuviation in Vertisols (Pal *et al*., 2006; Deshmukh., 2012) [12, 4]. Topography and slope were found to affect the particle size distribution (Ghode *et al*., 2023) [7]. The moisture retention at 33 kPa and 1500 kPa were analyzed and results shows that available water capacity (AWC) of the study area varied from 7.8 to 18.2 percent and plant available water capacity (PAWC) varied from 58.72 to 306.71 mm.

Chemical properties and Nutrient status

The pH range of the soils of the study area ranged from 7.35 to 8.98, was slightly to moderately alkaline. These soils ranged in electrical conductivity from 0.15 to 0.73, which is well below the permissible limit, and all of them fall within the non-saline class. The organic carbon content of soils varied from 0.12 to 0.60 per cent in different horizons and which was decreased with increase in depth of soil. The calcium carbonate content of these soils ranged from 10.50 to 20.50 per cent, indicating that the soils were calcareous in nature. However, it is observed that the Calcic Haplusterts having higher calcium carbonate in the Bca horizon in pure streak form but not hard in consistency. The cation exchange capacity of these soils varied from 48.52 to 66.72 in different horizons of the pedons. The cation exchange capacity of soil increased with increase in clay content of the pedons. In these soils the exchangeable calcium was dominant cation followed by magnesium, sodium and potassium ion on the exchange complex, indicating the presence of calcium bearing minerals in parent material. It was also observed that exchangeable cations increased from higher topography to lower topography which may be due to removal of exchangeable cations from higher topography and their deposition at lower topography but in the middle topography due to the manmade elevation on the rural constructions made the soils in the middle pediment with imperfect drainage with varying exchangeable cations. The bulk density of subsurface horizons is higher than the surface horizon in the soils and also noticed the hard layer in subsurface this indicated that the $CaCO_3$ tends to have a cementing effect and form hard pan in subsurface layer which restricted the infiltration and soil aeration and inhibits the root penetration. The high amount of $CaCO_3$ in root zone adversely effect on availability of nutrients.

In case of nutrient status, the soils were very low to medium in available nitrogen and phosphorus content and moderate to very high in available potassium content. The soils of the study area were sufficient in available Fe, Mn and Cu. However, deficient to sufficient in available Zn content in these soils where the Zn availability is very low and deficient in the soils of Marathwada region. On categorisation of the soils based om soil nutrient index, Avialable nitrogen, phosphorus, DTPA Cu, DTPA Fe were categorised under low category and organic carbon, DTPA Mn, boron were under medium and available potassium and DTPA Cu were under high nutrient index category.

Soil classification

Based on morphological, physical and chemical characteristics, the pedons under study have been classified as per keys to soil taxonomy (Soil Survey Staff, 2015). The dominant soils of the study area belonging to three orders *viz*. Entisols, Vertisol and Inceptisols. The soils developed on lower pediment belonged to the order of Vertisol and at sub group level this soil was classified under Typic Haplustepts whereas this soil was very deep, black coloured, clayey texture, wide cracks and well developed slicken sides with very fine clay particle with weighted mean more than 50 per cent. The soils developed on lower pediment belonged to the order of Vertisol and at sub group level this soil was classified under Calcic Haplusterts due to the presence of high calcium carbonate in the subsurface horizon and the soils in the upper pediment qualify for the order Entisol and at sub group level this soil was classified under Typic Ustothents with no distinct horizon development. The clay distribution in the Lithic Ustothents and Calcic Haplusterts were fine with weighted mean less than 50 per cent. The soil temperature class "isohyperthermic" for all the four pedons based on climatic data.

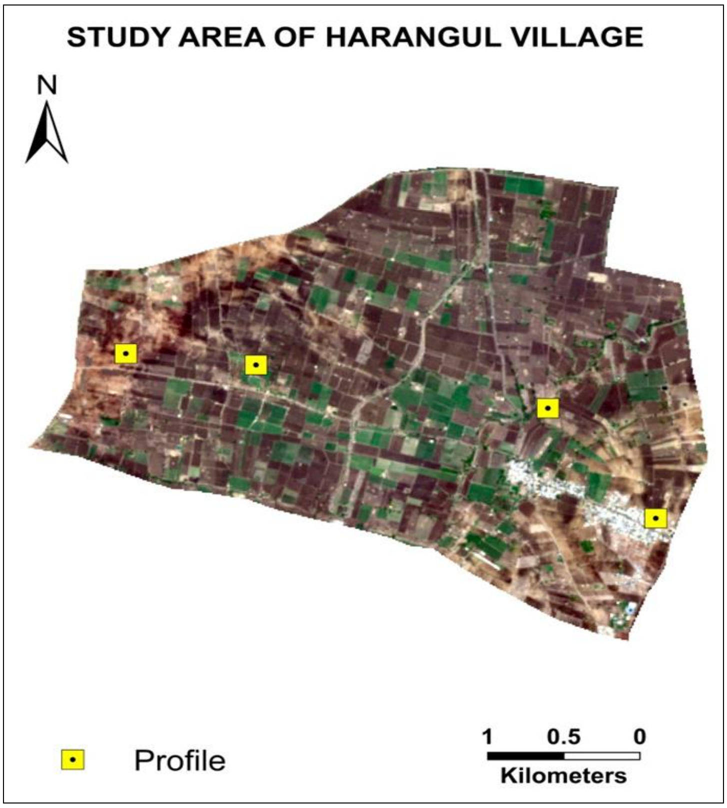

Fig 1: Location map of soil profile samples of Harangul village

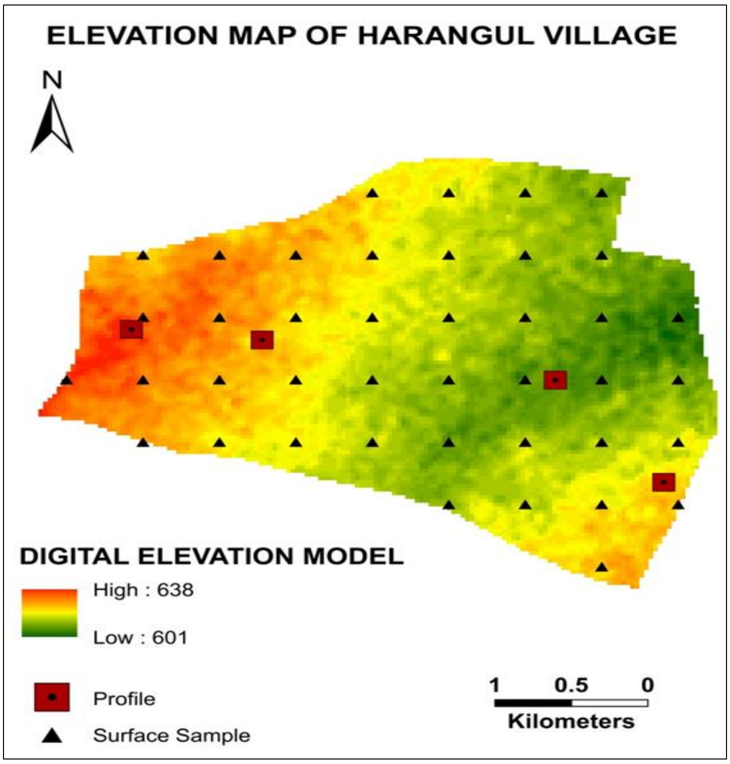

Fig 2: Elevation map of soil profile samples of Harangul village

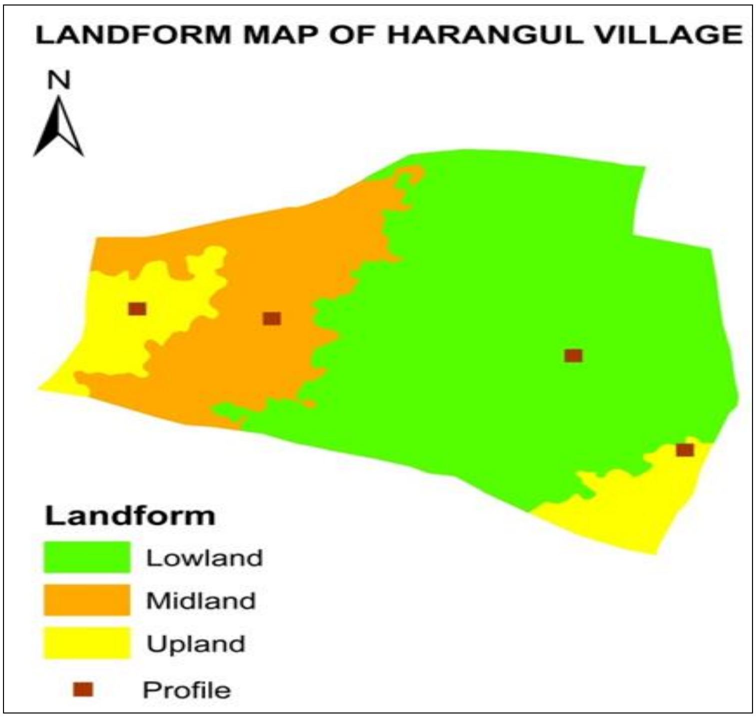

Fig 3: Landform map of soil profile samples of Harangul village

Table 1: Morphological characteristics of soils of Harangul Village

Horizon	Depth cm	Boundary	Colour	Texture	Structure	Consistency	Pores	Roots	Effervescence
Typic Haplustepts (P_1)									
Ap	0-12	cs	7.5YR 4/5	cl	m1 sbk	h,fr, ssps	f,vf,f	vf,f	e
Bw	12--35	as	7.5YR 3/3	cl	m2 sbk	fr, sp	vf, f, c	vf,f	e
Bc	35-62	gw	7.5YR 3/3	sl	m2 sbk	fr, ssps	vf, f, c	vf,f	es
Typic Ustorthents (P_2)									
Ap	0-30	aw	10YR 3/3	c	sbk	h, fr, spsp	vf, m	vf, m	e
C1	30-65	aw	10YR 4/2	scl	sbk	h, fr, spsp	f, m	vf, f	ev
Calcic Haplusterts (P_3)									
Ap	0-23	gw	10YR 2/2	c	m2 sbk	h, vfr, vsvp	vf, c	vf, c	es
Bw	23-48	gw	10YR 2/2	c	m2 sbk	h, vfr, vsvp	vf, c	vf,,c	es
Bss1	48-87	gw	10YR 2/2	c	m3 abk	h, vfr, vsvp	vf, c	vf,c	es
Bss2	87-120	gw	10YR 4/2	c	m3 abk	h, vfr, vsvp	vf, c	vf,c	ev
Bca	120-160	gw	10YR 4/3	c	m2 sbk	sh, vfr, vsvp	vf, m	vf,m	ev
Lithic Ustorthents (P_4)									
Ap	0-20	gw	10YR 3/2	c	m2 sbk	h, vfr, vsvp	vf, c	vf,f	e
Bw	20-58	as	10YR 3/2	c	m2 sbk	h, vfr, vsvp	vf, c	vf, f	e

Table 2: Physical properties of soils of Harangul village

					Particle Size				
Horizon	**S.No**	**Depth range**	**Depth**	**BD**	**Sand**	**Silt**	**Clay**	**AWC**	**PAWC**
		(cm)	(cm)	(Mg m^{-3})	(%)			(%)	(mm)
Typic Haplustepts (P_1)									
Ap	01	0-12	12	1.27	4.37	61.01	34.62	13.3	90.82
Bw	02	12--35	23	1.33	5.6	61.48	32.92	13.5	
Bc	03	35-62	27	1.39	20.96	48.87	30.17	7.8	
Typic Ustorthents (P_2)									
Ap	04	0-30	30	1.43	11.19	54.81	34	12.7	98.98
C1	05	30-65	35	1.57	27.53	35.12	37.35	8.1	
Calcic Haplusterts (P_3)									
Ap	06	0-23	23	1.35	6.54	32.8	60.65	9.5	306.71
Bw	07	23-48	25	1.34	5.98	29.39	64.62	12.2	
Bss1	08	48-87	39	1.43	4.58	29.39	66.01	13.5	
Bss2	09	87-120	33	1.57	5.21	28.3	66.48	18.2	
Bca	10	120-160	40	1.59	6.21	29.29	54.49	10.5	
Lithic Ustorthents (P_4)									
Ap	11	0-20	20	1.43	7.18	53.82	39	12	58.72
Bw	12	20-58	38	1.52	14.22	22.83	37.05	8.9	

Table 3: Chemical properties of soils of Harangul village

					Exchangeable Cations (Cmol (P^+) / Kg)					
Horizon	pH	EC (dS m^{-1})	OC (%)	$CaCO_3$ (%)	Ca^{++}	Mg^{++}	Na^+	K^+	Total	CEC
Typic Haplustepts (P_1)										
Ap	7.35	0.15	0.32	13.4	43.3	9.9	2.61	1.47	57.28	60.12
Bw	7.72	0.18	0.26	12.6	37.4	13.4	3.58	1.1	55.48	56.84
Bc	7.98	0.16	0.23	13.1	41.2	6	3.64	0.92	51.76	48.52
Typic Ustorthents (P_2)										
Ap	8.02	0.17	0.45	19	40.4	6.4	1.93	1.36	50.09	53.7
C1	8.04	0.19	0.23	20.21	37.9	5.3	1.99	0.97	46.16	50.6
Calcic Haplusterts (P_3)										
Ap	8.07	0.39	0.57	16.6	35.6	10.4	3.19	2.37	51.56	52.14
Bw	8.03	0.46	0.38	20.5	36.4	10	3.48	1.23	51.11	50.36
Bss1	8	0.63	0.41	14.09	32.8	19.4	2.74	0.8	55.54	58.6
Bss2	8.37	0.59	0.3	19	31.2	20.8	2.88	0.9	55.78	60.04
Bca	8.98	0.73	0.12	12	26.8	22	4.11	1.04	53.95	61.14
Lithic Ustorthents (P4)										
Ap	7.78	0.27	0.6	10.53	28	27.6	2.61	1.91	60.12	62.76
Bw	7.95	0.23	0.58	10.5	42.4	18	2.19	1.59	64.18	66.72

Table 4: Available nutrients status of soils of Harangul village

	Available Nutrients (Kg ha^{-1})			Micronutrients (Ppm)				
Horizon	N	P	K	Fe	Cu	Zn	Mn	B
Typic Haplustepts(P_1)								
Ap	175.62	7.02	306.29	7.42	16.83	11.25	8.91	0.67
Bw	163.07	5.92	359.09	7.2	16.57	9.64	8.07	0.54
Bc	137.98	5.48	443.59	6.95	15.25	10.17	8.99	0.33
Typic Ustorthents(P_2)								
Ap	150.53	6.36	1024.48	12.53	9.27	4.13	15.89	0.82
C1	137.98	4.39	380.22	11.52	6.15	4.05	15.41	0.69
Calcic Haplusterts(P_3)								
Ap	163.07	3.95	369.66	4.85	6.08	9.55	28.68	0.85
Bw	137.98	3.51	433.03	4.17	6.14	4.66	14.02	0.73
Bss1	112.9	4.39	390.78	7.53	6.07	3.13	9.45	0.68
Bss2	87.81	5.48	506.96	7.47	5.24	2.87	8.63	0.52
Bca	240.84	5.04	306.29	5.66	4.15	2.25	6.71	0.43
Lithic Ustorthents(P4)								
Ap	137.98	5.92	411	21.18	16.87	3.63	7.38	0.66
Bw	137.98	7.24	464.71	17.93	14.52	2.61	6.17	0.59

Conclusion

The study area Harangul village exhibits diverse soil characteristics, Soil depths vary from shallow to very deep, with noticeable surface cracks and slickensides. The bulk density ranges from 1.27 to 1.59 Mg m^{-3}, Particle size analysis reveals sand (1.04-5.31%), silt (29.79-41.85%), and clay (54.34-68.81%), with higher clay content in lower topographic positions. PAWC ranges from 90.82 to 306.71 mm. pH levels extent from neutral (7.35) to strongly alkaline (8.98). Organic carbon content varies from 0.12% to 0.60%, while calcium carbonate ranges from 10.50% to 20.50%. Nutrient availability shows low nitrogen and phosphorus levels but high potassium content and deficient to sufficient in micronutrients. The soils are classified as Inceptisols, Entisol and Vertisols with sub-group classifications based on distinct characteristics. Overall, these findings highlight the variability and complexity of soil profiles, essential for effective soil management and agricultural practices in farm VNMKV, Parbhani.

References

1. Berger KC, Truog E. Boron determination in soils and plants. Ind Eng Chem Anal Ed. 1939;11:540-545.
2. Black CA, Evans DD, White JL, Ensmingel LE, Clark FE. Method of soil analysis, part I. American Society of Agronomy, International Agronomy, Madison, Wisconsin, USA, 1965, 9.
3. Coughlan KJ, McGarry D, Smith GD. The physical and mechanical characterization of Vertisols. In: First Regional Seminar on Management of Vertisols under Semi-arid Condition, IBSRAM Proc. No. 6. Nairobi, Kenya, 1986, p. 89-106.
4. Deshmukh AA. Appraisal of land resources of Tandulwani watershed in Nagpur district, Maharashtra using remote sensing and GIS techniques. M.Sc. Thesis, Dr. PDKV, Akola, M.S, India, 2012.
5. Forkuor G, Hounkpatin OKL, Welp G, Thiel M. High resolution mapping of soil properties using remote sensing variables in southwestern Burkina Faso: a comparison of machine learning and multiple linear regression models. PLoS One. 2017;12:e0170478.
6. Gardner EA, Shaw RJ, Smith GD, Coughlan KJ. Plant Availability capacity concept, Measurement prediction. In: Properties and Utilization of Cracking Clay Soils. McGarity JW, Hoult EH, Co HB, editors. Armidale: University of New England, 1984, p. 164-75.
7. Ghode MK, Vaidya PH, Zade SP. Characterization, classification and its impact on yield and quality of tamarind in Marathwada region, Maharashtra. J Indian Soc Soil Sci. 2023;71(1):13-25.
8. Jackson ML. Soil chemical analysis. Prentice Hall of India

Pvt. Ltd, 1979, p. 545.
9. Jackson ML. Soil chemical analysis. Prentice Hall of India Pvt. Ltd, 1967. p. 205.
10. Jackson ML. Soil Chemical Analysis. Prentice Hall, Englewood Cliffs, New Jersey, 1958, p. 498.
11. Malode KR, Akansha S, Sharma CK. Soil-site suitability and evaluation for soybean crop on some Vertisols of Marathwada region of Maharashtra state. Plant Arch. 2021;21(1).
12. Pal DK, Bhattacharyya T, Chandran P, Ray SK, Satyavati PLA, Raja P, *et al*. Pedogenetic processes in shrink-swell soils of central India. Agropedology. 2006;16:12-20.
13. Patangray AJ, Patil NG, Pagdhune AR, Singh SK, Mishra VN. Vertical distribution of soil nutrients and its correlation with chemical properties in soils of Yavatmal district, Maharashtra. J Pharmacogn Phytochem. 2018;7(6):2799-2805.
14. Piper CS. Soil and Plant Analysis. 4th ed. University of Adelaide, Australia, 1966, p. 135-200.
15. Richards LA, editor. Diagnosis and improvement of saline and alkali soils. USDA Agric Handb. 60. Washington, D.C.: U.S. Govt. Printing Office, 1954, p. 160.
16. Sinha Y, Srivastava R, Patel J. Characterization and classification of shrink-swell soils of Nagpur district, Maharashtra. Int J Chem Stud. 2020;8(3):1979-1983.
17. Soil Survey Division Staff. Soil Survey Manual, Handbook No. 18. USDA, Washington, D.C, 2000.
18. Soil Survey Staff. Keys to soil taxonomy. 9th Ed. Natural Resources Conservation Service, United States Department of Agriculture (USDA), 2003.
19. Soil Survey Staff. Keys to soil taxonomy. 8th ed. Washington, D.C.: SCS, USDA, 1998.
20. Subbiah BV, Asija GL. Rapid procedure for the estimation of available nitrogen in soil. Curr Sci. 1956;25:259-260.
21. Vaidya PH, Pal DK. Micro topography as a factor in the degradation of Vertisols in central India. Land Degrad Dev. 2002;13(5):429-445.
22. Williams CH, Steinbergs A. Soil sulphur fractions as chemical indices of available sulphur in some Australian soils. Aust J Agric Res. 1959;10(3):340-352.
23. Wu T, Luo J, Dong W, Sun Y, Xia L, Zhang X. Geo-object-based soil organic matter mapping using machine learning algorithms with multi-source geo-spatial data. IEEE J Sel Top Appl Earth Obs Remote Sens. 2019;12:1091-1106.