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# Analysis of fertility nutrients present in the soil of Bageshwar district (Uttarakhand)

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### Abstract
The entire work program is based on soil analysis, which is an important tool to check the fertility status for crop production. Soil fertility indicators such as pH, available carbon, phosphorous, potassium, and minerals (Fe, Cu, Mn, Zn) content were identified. Different techniques like the glass electrode method (for pH), Walkey & Black method (for soil organic carbon), Truog method (for Phosphorus), Flame Photometry (for Potassium), turbidimetric method (for S), and Atomic Absorption Spectroscopy (micronutrients) were employed, and results were analysed. The analytical results confirmed that organic matter content falls in the high range, soil pH alkaline to acidic, essential nutrients sulphur, phosphorous and potassium low to high and micronutrients Fe, Cu, and Zn fall in the high range except Mn in most of villages in Bageshwar district.

**Keywords:** Soil analysis, Bageshwar, Uttarakhand, macro and micronutrients

## Introduction
Basically, the soil is naturally efficient in macronutrients e.g., C, K, P, S, and micronutrients, e.g., Fe, Cu, Mn. These are essential for inclining soil productivity and yielding maximum quality and quantity of the crop. It is composed of small particles of rocks and contains humus. Soil fertility relates to accessibility of soil nutrients (micro and macro) and other components. Mainly over crop productivity disturbs the physicochemical parameters of soil and affect the quality of crop. The micronutrients have higher solubility at a low pH, and extremely low and high pH values lead to the collapse of crop production due to a misbalance in ionic potency [1]. The significant difference between the nutritional level of industrial and nonindustrial fertile land due to effluent-release wastes [2]. The water holding capacity, OC %, and pH found a trend in different seasons [3]. The Himalayan forest soil contains high organic matter content [4]. Many researchers have also reported the macro and micronutrient status of the soil in various parts of India [5, 6, 7, 8, 9, 10, 11]. Soil testing is necessary for the high yield of crops. However, information about the availability of fertility nutrients in the soil of Bageshwar is lacking. Therefore, in the present work, the status of macro and micronutrients in the soil of Bageshwar was assessed to provide information about the fertilizer recommendation for facilitating good yield of crops.

## Material and Methods
### Study area
Bageshwar is situated in the central Himalayan region of Uttarakhand and is located at 29.49° North latitude, 79.45° East longitude, with an altitude of 935 m above sea level. Bageshwar district has a pleasant temperature throughout the year, having an average rainfall of 1221.7 mm.

### Sample Collection
Soil samples were collected from the surface (0-15 cm) using a spade with proper labeling from the different villages of Bageshwar district.

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**Fig 1:** Sampling locations

**Analysis of sample**
Samples were dried in a shady place, crushed with the help of a crusher machine, sieved through a sieve, and then utilized for the analysis of pH, organic matter, macro and micronutrients by espousing various laboratory techniques. Hydrogen ion concentration is indicated by measuring the pH of the solution. pH estimation of the soil was carried out by taking soil in 1:2 with distilled water using Glass electrode pH meter [12], organic carbon content by titration method [13], available phosphorous was extracted by 0.002 ml $H_2SO_4$ solution and 2ml of ammonium molybdate followed by 5 drops of $SnCl_2$ solution [14], and available Potassium was estimated by swirling the soil with ammonium acetate solution, 40% ethyl alcohol and then analyzed by Flame Photometer [15]. S was estimated by turbidimetric method using UV Spectrophotometer [16], and micronutrients such as Cu, Fe, Mn, and Zn were extracted with 20ml DTPA then estimated by Atomic Absorption Spectrometer [17].

**Result and Discussion**
**Soil pH**
The pH range of soil was measured 6.12-8.02 (Kapkot), 6.22-7.72 (Bageshwar) between, and 6.35-7.32 (Garud), showing it is acidic to moderately alkaline; previously, it has been reported that pH (6.5-7.5) is very harmonious for plant growth [18].

**Organic Matter Content (%)**
Organic matter content is the most plentiful macronutrient in the earth's crust. The percentage of organic matter content varied from 0.07-2.65% in Kapkot, 0.14-2.70% in Bageshwar, and 0.42- 2.64% in Garud blocks, indicating high organic matter content in the soil of the study area. Earlier, same comparable result was also reported [19].

**Available Potassium (kg/ha)**
The availability of Potassium was found to be high (425.60 kg/h) in Pachar, low in Badiyakot (116.88 kg/h), Bharari (52.64 kg/h), and Garkhet (95.20 kg/h) medium in rest of villages in Kapkot (116.88-218.40 kg/h). In the Bageshwar block, the value of potassium content was found to be low (40.08 kg/ha) in Kanday, (116.48 kg/h) in Dhari, and the rest of the villages contain medium to high (168.00-1214 kg/h). Garur block also had medium to high (183.68-1099.84 kg/h) values.

**Available phosphorous (kg/h)**
The phosphorous varied from 13.50-36.00 kg/h, 4.50-58.50 kg/h, and 9.00-27.00 kg/h in the Kapkot, Bageshwar and Garur block soil, respectively. Only Gharkhet village of Kapkot block has a high phosphorous value (36.00 kg/h) and medium for the rest of the villages. Dhari (9.00 kg/h), Mulsuna (9.00 kg/h) and Taknar (4.50 kg/h) villages of Bageshwar block and Talihat (9.00 kg/h), Kursali (9.00 kg/h) villages of Garur block contain low value and medium to high for rest of the villages.

**Sulfur (ppm)**
The value of sulphur was found to be deficient at 7.59 ppm in Badiyakot, 5.69 ppm in Garkhet in Kapkot block, and the rest, ranging from 10.62 ppm -24.18 ppm, was found to be high. 7.88 ppm, 8.05 ppm, and 9.24 ppm low values were observed in Khankar, Chati, and Kanday, respectively, in Bageshwar block and other villages having a high value from 10.07 ppm - 24.15 ppm. Considering the 10.0ppm as a critical limit of S, six villages were found to contain a low amount of sulfur, and the rest had high sulfur levels in the Garur block. The reason for the high value of sulfur was due to the acidic reaction of % OC and low EC values [20].

**Iron (ppm)**
The available iron content ranged from 29.56-46.68 ppm, 11.22-42.38 ppm, and 19.56-44.56 ppm in the Kapkot, Bageshwar, and Garur block soil, respectively. Overall, the available iron status was high for all the villages. Some identical type result was also suggested by other researcher [21].

**Copper (ppm)**
0.20 ppm as the critical range for copper, soil was found to have a high value of copper in Bageshwar.

**Manganese (ppm)**
The manganese present in the soil of study areas ranged from 1.05- 19.56 ppm. The status of available manganese was found to be high in 17 villages, and the remaining villages were low in manganese content in all three blocks.

**Zinc (ppm)**
The zinc availability in the soil ranged from 1.16-4.52 ppm. Considering the critical limit from 0.54 to 0.60 ppm, none of the study region was deficient in zinc.

**Table 1:** Soil parameters (Kapkot block)

| Sl. No. | Name of block | Name of villages | pH | OC% | K (kg/h) | P (kg/h) | S (ppm) | Fe (ppm) | Cu (ppm) | Mn (ppm) | Zn (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Kapkot | Badiyakot | 8.02 | 2.65 | 116.88 | 13.65 | 7.59 | 46.68 | 2.94 | 13.90 | 3.16 |
| 2 | - | Garkhet | 7.97 | 2.64 | 95.20 | 36.00 | 5.69 | 38.06 | 2.56 | 1.45 | 2.90 |
| 3 | - | Liti | 7.85 | 2.61 | 151.20 | 18.00 | 11.18 | 45.00 | 3.04 | 1.76 | 1.50 |
| 4 | - | Bharari | 6.12 | 1.26 | 52.64 | 15.00 | 24.18 | 39.60 | 2.28 | 1.48 | 2.90 |
| 5 | - | Munar | 7.85 | 2.55 | 175.85 | 13.50 | 10.59 | 30.48 | 2.84 | 1.18 | 2.12 |
| 6 | - | Pachar | 6.72 | 2.62 | 425.60 | 18.00 | 13.86 | 29.56 | 1.92 | 18.12 | 2.78 |
| 7 | - | Jakhani | 6.80 | 0.07 | 185.92 | 22.50 | 10.62 | 35.18 | 2.68 | 11.56 | 3.16 |
| 8 | - | Saneti | 7.00 | 0.91 | 218.40 | 22.56 | 11.55 | 37.18 | 2.06 | 19.20 | 2.42 |

**Table 2:** Soil parameters (Bageshwar block)

| Sl. No. | Name of block | Name of villages | pH | OC% | K (kg/h) | P (kg/h) | S (ppm) | Fe (ppm) | Cu (ppm) | Mn (ppm) | Zn (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bageshwar | Mandalsera | 7.48 | 2.70 | 1214.0 | 58.50 | 13.14 | 40.68 | 4.68 | 19.56 | 3.98 |
| 2 | - | Joshigaon | 7.72 | 0.14 | 473.20 | 27.00 | 10.07 | 30.00 | 3.28 | 19.50 | 4.52 |
| 3 | - | Sainj | 6.56 | 1.65 | 244.16 | 22.50 | 13.65 | 11.22 | 2.78 | 19.36 | 3.06 |
| 4 | - | Dhari | 7.30 | 0.45 | 116.48 | 9.00 | 18.94 | 19.22 | 4.28 | 10.84 | 4.28 |
| 5 | - | Mulsuna | 6.96 | 1.53 | 188.16 | 9.00 | 13.92 | 36.12 | 13.20 | 18.09 | 2.18 |
| 6 | - | Khankar | 7.74 | 0.79 | 432.32 | 22.50 | 7.88 | 28.10 | 2.72 | 15.46 | 3.12 |
| 7 | - | Kanday | 7.12 | 1.11 | 40.08 | 22.50 | 9.24 | 16.84 | 3.38 | 8.84 | 4.16 |
| 8 | - | Dunga Patli | 7.25 | 1.27 | 344.44 | 27.00 | 10.12 | 31.68 | 11.10 | 15.2 | 1.68 |
| 9 | - | Chhati | 6.72 | 0.51 | 206.00 | 22.50 | 8.05 | 16.04 | 3.18 | 14.12 | 3.44 |
| 10 | - | Chaura | 6.84 | 1.74 | 201.60 | 22.50 | 11.81 | 29.40 | 8.66 | 1.67 | 2.78 |
| 11 | - | Panchor | 6.70 | 2.11 | 347.20 | 18.00 | 12.47 | 40.12 | 2.62 | 10.18 | 2.60 |
| 12 | - | Taknar | 6.52 | 2.35 | 239.68 | 4.50 | 12.09 | 42.38 | 9.58 | 1.26 | 2.30 |
| 13 | - | Kholiyagaon | 6.22 | 0.48 | 168.00 | 27.00 | 24.15 | 33.10 | 1.62 | 16.20 | 4.30 |
| 14 | - | Ghiroli | 7.29 | 0.64 | 175.80 | 22.50 | 15.11 | 37.10 | 11.14 | 1.31 | 1.90 |

**Table 3:** Soil parameters (Garur block)

| Sl. No. | Name of block | Name of villages | pH | OC% | K (kg/h) | P (kg/h) | S (ppm) | Fe (ppm) | Cu (ppm) | Mn (ppm) | Zn (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Garur | Chaurson | 7.32 | 0.63 | 286.72 | 27.00 | 5.62 | 33.12 | 9.28 | 1.74 | 2.00 |
| 2 | - | Purara | 6.35 | 0.50 | 310.24 | 18.0 | 9.64 | 34.16 | 11.56 | 1.29 | 3.00 |
| 3 | - | Kasauli | 6.76 | 0.42 | 256.48 | 22.50 | 10.05 | 33.46 | 11.40 | 1.20 | 1.80 |
| 4 | - | Wajula | 6.85 | 1.02 | 240.80 | 22.50 | 10.65 | 37.48 | 9.02 | 1.41 | 2.02 |
| 5 | - | Pinglo | 6.88 | 2.64 | 369.60 | 27.00 | 15.53 | 44.56 | 2.70 | 1.74 | 2.28 |
| 6 | - | Gagrigol | 7.04 | 2.23 | 370.72 | 13.50 | 5.95 | 39.24 | 18.40 | 1.62 | 2.58 |
| 7 | - | Talihat | 6.57 | 1.47 | 407.68 | 9.00 | 3.84 | 40.08 | 2.64 | 1.81 | 1.32 |
| 8 | - | Ayartoli | 6.66 | 2.36 | 798.56 | 31.50 | 7.94 | 30.48 | 1.56 | 11.84 | 2.48 |
| 9 | - | kursali | 7.30 | 2.62 | 1067.36 | 9.00 | 15.84 | 21.84 | 11.66 | 1.63 | 1.40 |
| 10 | - | Bunga | 6.83 | 2.64 | 683.20 | 13.50 | 11.08 | 19.56 | 9.72 | 1.05 | 1.24 |
| 11 | - | Kausani | 6.86 | 1.12 | 183.68 | 13.50 | 17.24 | 36.56 | 13.40 | 1.98 | 2.42 |
| 12 | - | Koottukari | 6.85 | 2.64 | 1099.84 | 13.51 | 20.06 | 30.48 | 10.52 | 1.94 | 1.16 |
| 13 | - | Jakhera | 6.69 | 1.50 | 788.48 | 22.50 | 9.76 | 34.52 | 2.00 | 18.22 | 3.30 |
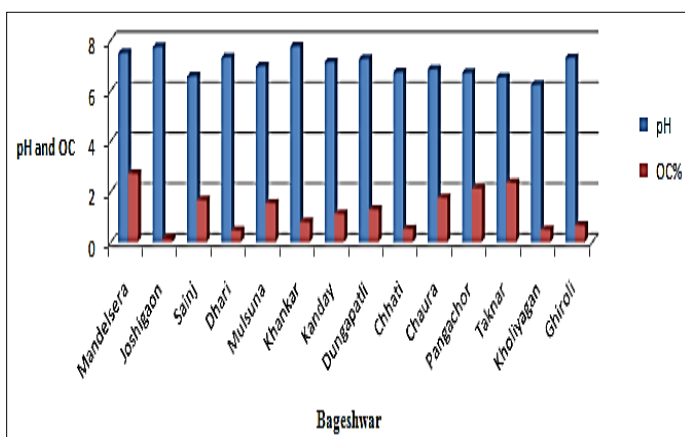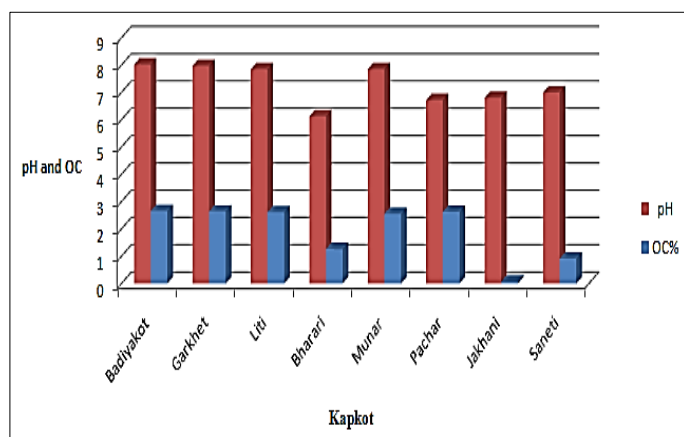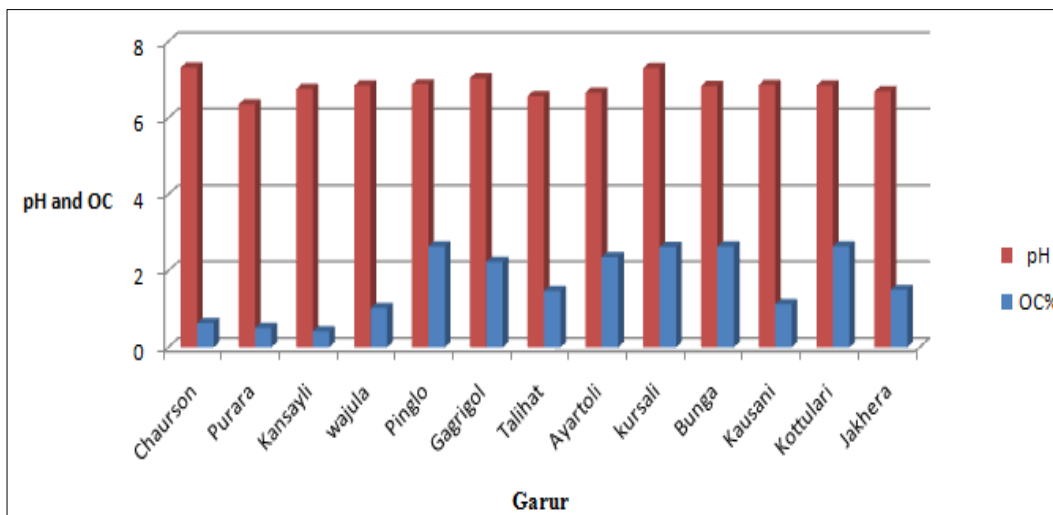
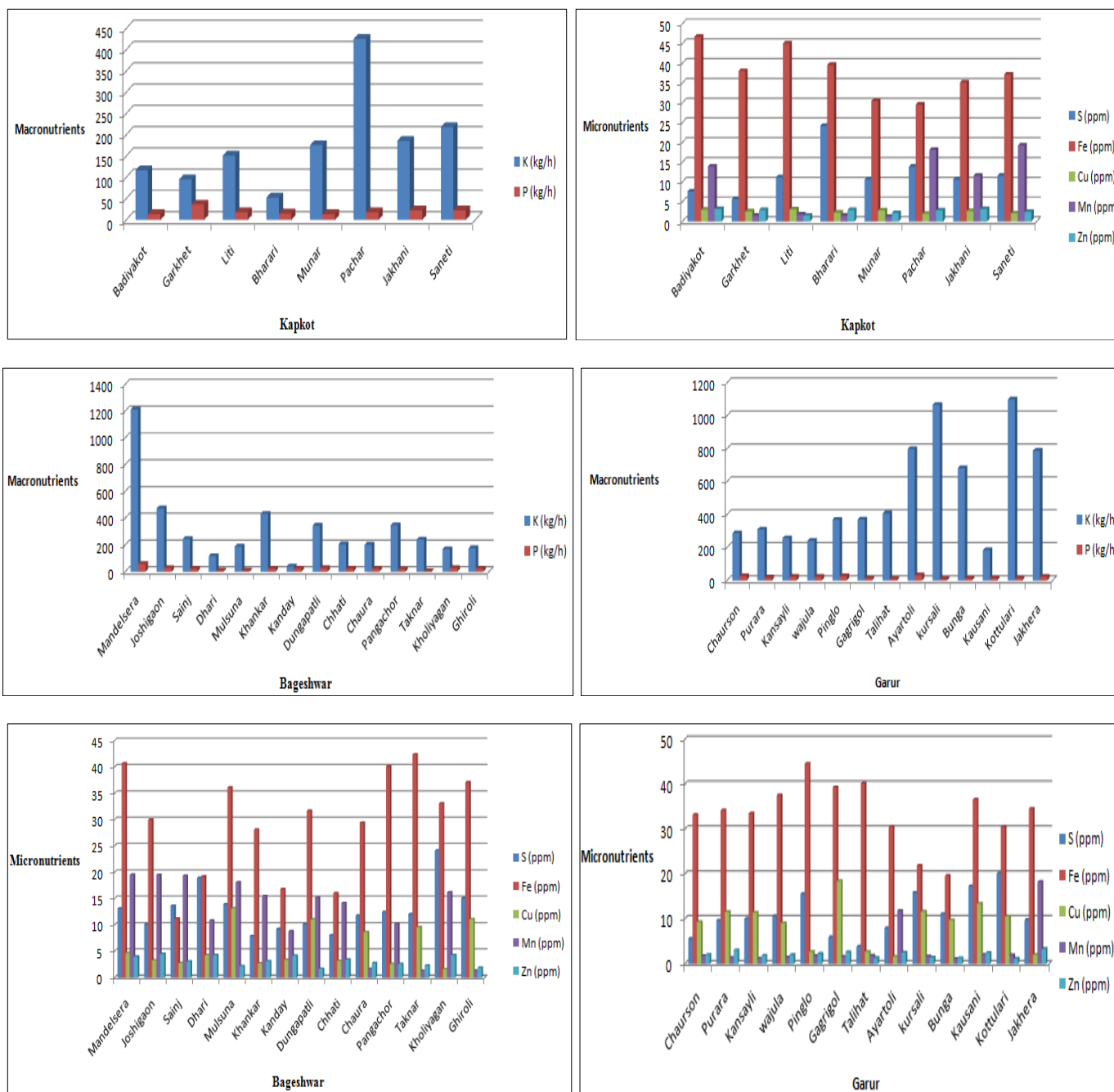**Fig 2:** Graphical representation of pH and OC %



**Fig 3:** Graphical representation of Macronutrients and Micronutrients

## Conclusion
Soil of Bageshwar district was found mainly sandy loam and greyish-brown. Systematic monitoring and nutrient management of soil become important as the results of the study area reveal most of the villages having acidic to alkaline pH values, high percentage of organic matter content and varying status of micro and macro nutrients in different villages of Bageshwar district. Therefore the soil requires distinct attentiveness for increasing the production of crops. It can be helpful to improve the economic condition and daily requirements of small farmers residing in rural hilly regions.

## Acknowledgement

## References
1. Kumar S, Iyer A, Agarwal S. Cotton yield in relation to physicochemical properties of cultivated soil of Rajkot region. Int. J Adv. Eng. Tech. 2011;2(3):52-55.
2. Mobar S, Kaushik PBP. Physiochemical comparison of textile effluent impacted and unimpacted agricultural soil of Jaipur city, India. Int. J Recent Sci. Res. 2015;6(3):3090-3093.
3. Joshi PC, Pandey P, Kaushal BR. Analysis of some physicochemical parameters of soil from protected forest in Uttarakhand. Nature and Science. 2012;11(1):136-140.
4. Arya SC, Samant SS. Assessment of habitat diversity, distribution of vegetation and human dependence in alpine meadows of Nanda Devi Biosphere Reserve, West Himalaya. Int. J Adv. Res. 2002;5(9):1349-1366.
5. Khedkar MB, Patil DA, Bhagat AD, Sharma HC, Beldar RM. Available Macro and Micronutrient Status in the Soils of Garud Watershed in Bageshwar District of Uttarakhand (U.K) in Relation to Soil Characteristics. Int. J Curr Microbiol. Appl. Sci. 2020;9(12):1013-1024.
6. Meena HB, Sharma RP, Rawat US. Status of some macro and micronutrients in some soils of Tonk district of Rajasthan. J Indian Soc. Soil Sci. 2006;54(4):508-512.
7. Gupta UC, Wu K, Liang S. Micronutrients in Soils, Crops, and Livestock. Earth Sci. Front. 2008;15(5):110-125.
8. Prasad B, Sinha NP. Changes in the status of micronutrients in soil with long term applications of chemical fertilizers, lime and manure. Plant Soil. 1982;64(3):437-441.
9. Kumar A, Mishra VN, Srivastav LK, Banwasi IGKV. Evaluations of soil fertility status of available major nutrients (N, P & K) and micro nutrients (Fe, Mn, Cu & Zn) in Vertisol of Kabeerdham District of Chhattisgarh, India. Int. J Interdiscip. Multidiscip. Stud. 2014;1(10):72-79.
10. Rajeswar M, Rao CS, Balaguravaiah D, Khan MA. Distribution of available Macro and micronutrients in soils of Garikapadu of Krishna district of Andhra Pradesh. J Indian Soc. Soil Sci. 2009;57(2):210-213.
11. Sood A, Sharma PK, Tur NS, Nayyar VK. Micronutrient status and their spatial variability in soils of Muktsar district of Punjab - A GIS approach. J Indian Soc. Soil Sci. 2009;57(3):300-306.
12. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi; c1973.
13. Walkley A, Black CA. Estimation of organic carbon by the chromic acid titration method. Soil Science. 1934;37:29-38.
14. Truog E. The determination of readily available phosphorous in soils. J Am Soc. Agron. 1930;22(10):874-882.
15. Metson AJ. Methods of chemical analysis for soil survey samples. Soil Science. 1957 Mar 1;83(3):245.
16. Chesnin L, Yien CH. Turbidimetric Determination of Available Sulfates. Soil Sci. Soc. Am J. 1951;15(C):149-151.
17. Lindsay WL, Norvell WA. Development of a DTPA Soil Test for Zinc, Iron, Manganese, and Copper. Soil Sci. Soc. Am J. 1978;42(3):421-428.
18. Mesfin K, Yifru. Abera. Assessment on the Status of Some Micronutrients in Vertisols of the Central Highlands of Ethiopia. Int. Res J Agric. Sci. Soil Sci. 2013;3(5):169-173.
19. Tripathi PP, Aneja A. Analytical Investigation of Agricultural Soil from Different Areas of Kiccha Regions in U. S. Nagar - Uttarakhand. Int. J Adv. Sci. Res. Manag. 2019;4(6):71-74.
20. Ashok LB, Srinivasmurthy CA. Sulphur Status of Selected Soil Series of Karnataka and Studies on Direct and Residual Effect of Graded Levels of Sulphur on Crops. University of Agricultural Sciences GKVK; c2001.
21. Arya RP, Pachauri SP, Srivastava PC. Status of some macro- and micro-nutrients in soils of Almora district of Uttarakhand. Pant Nagar J Res. 2019;17(2):138-146.