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Assessment of soil health parameters from different blocks of Kota district, Rajasthan

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Abstract
Proper evaluation of soil is essential to soil health maintenance and sustainable agricultural development. This study entitled "Assessment of Soil Health Parameters from different blocks of Kota district, Rajasthan" was conducted during the year of 2020–2021. The objectives of this investigation were to determine the variations in Soil Physico-chemical properties and to learn about the Soil health status by finding out the deficiency and toxicity of different soil nutrients and provide Soil Health Card to the farmers. For the assessment, a total of 27 soil samples were collected from 3 different depths (0–15, 15–30 and 30–45 cm) from aggregate nine villages of three blocks of Kota district of Rajasthan. Soil samples were analysed using standard laboratory techniques. Findings revealed sandy clay loam to clay loam Soil Texture and Bulk density range of 1.05–1.25 Mg m^{-3} with good Water Holding Capacity (42.10 – 65.38%). Soil pH is Neutral to moderately alkaline with a mean value range of 7.26– 7.97 and the Electrical Conductivity suitable for all crops with a mean value of 0.20 – 0.41 dS m^{-1}. Soil Organic Carbon is medium to high range (0.26 – 0.76%). Available Nitrogen (mean value range of 316.9 – 390.9 kg ha^{-1}), Phosphorus is medium to high (mean value range of 13.77 – 25.77 kg ha^{-1}) and Potassium (mean value range of 174.1 – 248.7 kg ha^{-1}), Sulphur (24.37 – 34.39 kg ha^{-1}) is sufficient. Calcium and Magnesium are sufficient (8.97 – 16.47 and 3.9 – 12.4 cmol (p^+) kg^{-1}). Among micro-nutrients, Copper (0.15 – 1.04 mg kg^{-1}) content is sufficient whereas, Iron (2.34 – 6.72 mg kg^{-1}), Manganese content (2.24 – 2.61 mg kg^{-1}) and Zinc content (0.30 – 1.27 mg kg^{-1}) is low. On the basis of analysis, it was found that majority of soil profile of the study area is nutrient efficient and do not require external nutrition.

Keywords: soil health, physico-chemical properties, parameters, sufficient, deficient, soil health card

Introduction
Soil health is defined as the continued capacity of soil to function as a vital living system, by recognizing that it contains biological elements that are key to ecosystem function within land-use boundaries. In general, soil health and soil quality are considered synonymous. Soil quality is defined as "the capacity of a soil to function, within ecosystem and land use boundaries, to sustain productivity, maintain environment quality, and promote plant and animal health" (Doran and Parkin, 1994) [6].

Soil health deals with both inherent and dynamic soil quality. The inherent soil quality relates to the natural (genetic) characteristics of the soil (e.g., texture), which are the result of soil-forming factors. On the other hand, dynamic soil quality component is readily affected by management practices and relates to the levels of compaction, biological functioning, root proliferation, etc. The dynamic component is of more interest to growers because good management allows the soil to come to its full potential (Das, 1996).

For example, in an agricultural field, the capacity of a soil to function at sustaining crop growth would depend on several soil characteristics including bulk density, soil moisture, infiltration, and biological activity, to name a few. Many of these properties can be changed by management (e.g., infiltration and organic matter content) and soil quality can be improved according to its function. There are several criteria to consider soil health and soil quality indicators In general appropriate indicators should be easy to access, able to measure changes in soil function both at plot and landscape scales, assessed in time to make management decisions, accessible to many farmers, sensitive to variations in agro-ecological zone, representative of physical, biological or chemical properties of soil and assessed by either qualitative or quantitative both approaches (Schoonover and Crim, 2015) [15].

Rajasthan is located on the north-western side of India. The state covers an area of 3, 42,239 square kilometers or 10.4 percent of the total geographical area of the country.

Out of the total geographical area in the State, even 50 percent is not cultivable and within cultivable land, soil fertility varies considerably across districts. The wide differences in land productivity indicate the variation in soil health across districts in the State. The south east and eastern part of Aravali range is productive for agriculture purposes having clay loam soil type. Kota district is situated in the south-eastern part of Rajasthan and comes under Agro climatic zone V. Kota is also known as education city of Rajasthan. It is the third largest city of Rajasthan after Jaipur and Jodhpur with an area of 5217 km^2. The district has six Tehsils namely Ladpura, Digod, Pipalda, Ramganjmandi, Sangod & Kanwas. Out of which first three Tehsils comes under Chambal Command Area whereas last three Tehsils comes under non-Command area. Precipitation in Kota region happens amid the southwest monsoon and the upper east rainstorm season. The region gets higher precipitation from the southwest monsoon. The average annual rainfall of the district varies from 650 to 1000 mm. The total cultivated area of the district is 3.4 lac ha out of which 2.1 lac ha is irrigated. Though a big part of Rajasthan is in the form of desert, but because of Chambal River, Kota along-with its 3 adjoining districts, altogether known as Hadoti region, is a productive and bio diversifying region.

Study site

Kota district is situated between 24º25’ and 25º51’ North latitude and 75º37’ and 77º26’ East longitude in the southeast of the territory of Rajasthan with an average elevation of 271 metres (889 ft). Geographical area of Kota district is 5217 square kilometer with cultivable area of 3400 square kilometer. The average minimum temperature was recorded 10.6°C in winters and maximum 42.6°C in summers. About 93% of the annual rainfall is received during the South West monsoon season. The average annual rainfall of the district varies from 650 to 1000 mm. Kota district consists of 5 Tehsils/ CD blocks and 156 gram panchayats. Soil sampling was done from total nine villages of three blocks, namely Ramganjmandi (Block 1), Sangod (Block 2) and Ladpura (Block 3).

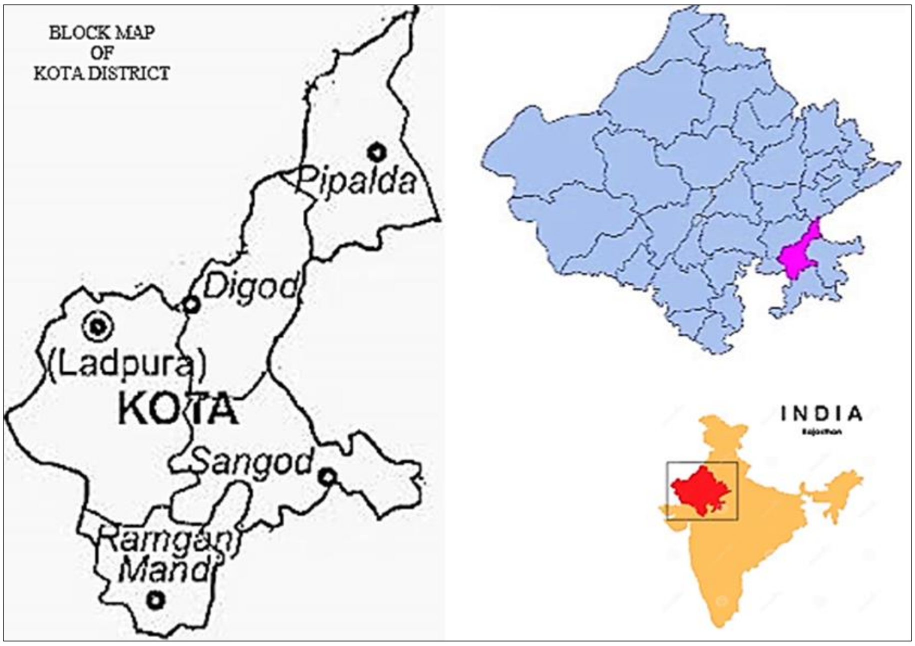

Fig 1: Map Showing Study Area

Methodology

A total of 27 soil samples were collected from different site using soil auger, screw auger and khurpi at the depth of 0-15cm, 15-30 cm and 30-45 cm. The collected soil samples were air dried in shade, clods were broken with wooden mallet and powdered soil is then sieved with 2mm sieve and analysed for Physico-chemical parameters in laboratory. The physical parameters include soil texture, bulk density, particle density, water retaining capacity, whereas chemical parameters include pH, Electrical conductivity, Organic Carbon, Macro-Nutrients (N, P, K, Ca, Mg, S) and Micro-Nutrients (Fe, Cu, Zn, Mn). Soil textural class was determined by using Bouyoucos Hydrometer (Bouyoucos, 1927). Bulk density, Particle density, Water holding capacity was determined by using Graduated Measuring Cylinder method (Muthuval *et al.*, 1992) [10]. pH was estimated with the help of Digital pH meter after making 1:2 soil water suspension (Jackson, 1958). Electical Conductivity was estimated with the help of Digital Conductivity meter (Wilcox, 1950) [21]. Percent Organic Carbon was estimated by Wet Oxidation method (Walkley and Black, 1947). Available Nitrogen was estimated by Alkaline Potassium Permanganate method, using Kjeldahl apparatus (Subbiah and Asija, 1956) [18], available Phosphorus was estimated by Olsen’s extraction followed by Spectrophotometric method (Olsen *et al.*, 1954) [14], available Potassium was estimated by Neutral normal Ammonium Acetate extraction followed by Flame photometric method (Toth and Prince, 1949) [19], Exchangeable Ca^{2+} and Mg^{2+} were estimated by Normal Ammomium Acetate saturation method (Cheng and Bray, 1951) [3], available Sulphur was estimated by Turbidimetric method followed by Spectrophotometric analysis (Chesnin and Yien, 1950) [4]. Available Fe, Cu, Zn and Mn were estimated by DTPA extraction followed by AAS analysis (Lindsay and Norvell, 1978) [9].

Result and Discussion

The study revealed Clay loam to Sandy Clay loam texture which indicates that there is nearly equal parts of Sand, silt and clay. Soils can hold good amount of nutrients but they are moderately susceptible to compaction as we go down the depth. Soils are found to have low bulk density in range of 1.09 – 1.22 Mg m^{-3}, which infers that soils are loose, rich in organic matter, well aggregated and porous in upper layers. Particle density of the soils were found to be in range of 2.19 – 2.58 Mg m^{-3}. Particle density of soils considers only the mineral solids present in soil. Water holding capacity of soils in different villages were found to be in range of 42.10 – 65.38%. Surface soils were found to have good water holding capacity than sub surface soils because of the decreasing organic matter content down the depths.

Table 1: Assessment of physical properties of soil from different blocks of Kota district

Village Name	Soil Textural Class	Bulk density		Particle density		Water holding capacity	
		Range	Mean	Range	Mean	Range	Mean
Ramganjmandi							
Khairabad	Clay loam	1.05-1.11	1.09	2.22-2.85	2.58	55.00-65.38	60.17
Manda	Sandy clay loam	1.11-1.25	1.18	2.00-2.50	2.24	45.83-52.94	49.59
Telya Kheri	Clay loam	1.17-1.25	1.22	2.00-2.66	2.39	51.42-58.33	55.10
Sangod							
Kolani	Sandy clay loam	1.05-1.17	1.11	2.10-2.25	2.19	51.42-56.75	54.39
Bacchihera	Sandy clay loam	1.05-1.25	1.14	2.00-2.85	2.36	55.00-63.51	60.34
Sawan Bhadon	Clay loam	1.05-1.17	1.11	2.22-2.66	2.46	43.18-50.00	47.37
Ladpura							
Dhakarkheri	Clay	1.11-1.25	1.18	2.22-2.85	2.58	54.79-59.72	57.69
Chareenda	Clay	1.11-1.17	1.13	2.10-2.50	2.27	45.07-64.86	55.18
Arampura	Clay loam	1.11-1.17	1.15	2.22-2.85	2.52	42.10-50.00	45.92

Soil pH and EC: Soil pH is a measure of alkalinity and acidity in soil. The soils of Kota district are suitable for most of the crops as they are neutral to moderately alkaline with pH range of 7.2 – 8.0 as the district receives a good amount of precipitation. The range and mean of pH and Electrical conductivity values of different villages are given in Table 2. Soil pH influences the availability of essential nutrients. High pH in some blocks of Kota resulted in reduced availability of most micronutrients. The Electrical conductivity of soil samples ranges between 0.17 – 0.47 dS m^{-1} which indicates that soils are suitable for cultivation of almost all crops.

Organic Carbon: Higher soil organic carbon improves soil aeration, water drainage, retention, and reduces the risk of erosion and nutrient leaching. It is also an index of availability of Nitrogen in soils. The Soils of Kota district were found to be rich in % Organic Carbon with mean value range of 0.26 – 0.76% with highest percent Organic Carbon found in villages of Sangod block. The range and mean values of different Chemical properties are given in Table 2.

Available Nitrogen: Nitrogen is important for plant growth, metabolism and the creation of chlorophyll**.** The available Nitrogen content of the three blocks of Kota district ranges between 316.9 – 390.9 kg ha^{-1} which reflects that it is in medium range according to the limits suggested by Muhr *et al*., 1965 [11] and also indicating that % Organic Carbon is correlated with Nitrogen content of soil.

Available Phosphorus: Phosphorus is vital to plant growth. It plays important functions like energy transfer, photosynthesis and nutrient movement within the plant. But excessive soil Phosphorus reduces the Plant's ability to take up required micronutrients, particularly Iron and Zinc, even if they are adequate. Available Phosphorus of soils of Kota district was found in the range of 13.7 – 25.7 kg ha^{-1} which is medium in Ramganjmandi and Sangod Block and slightly high in Ladpura block.

Available Potassium: Potassium is important for ensuring optimal plant growth. It is an activator of dozens of important enzymes, such as protein synthesis, sugar transport, etc. It is vital to the retention and absorption of water in crop soil. Available Potassium content of all three blocks of Kota district was found in the medium range i.e.174.1 – 248.7 kg ha^{-1}. The range and mean values of Primary nutrients are given in Table 3.

Exchangeable Ca and Mg: Calcium is an essential plant nutrient required by plants in relatively large amounts for healthy growth. Calcium improves the absorption of other nutrients by roots and their translocation within the plant whereas Magnesium is the center molecule of chlorophyll, improves the utilization and mobility of phosphorus. Exchangeable Ca and Mg in Soils were found to be high in the range of 8.97 – 16.47 cmol (p^+) kg^{-1} and 3.9 – 12.4 cmol (p^+) kg^{-1} respectively which is due to the high clay content in soil.

Available Sulphur: Sulphur is used in the formation of amino acids, proteins, and oils. It is crucial in nodule development and efficient nitrogen fixation in legumes. The available Sulphur content of the three blocks of Kota district was found sufficient in range of 24.37 – 34.39 kg ha^{-1}. Soils of the district are considered good for production of Oilseed crops like Soybean and Mustard. The range and mean values of Secondary nutrients are given in Table 4.

Iron: Iron is present in several important enzymes. It is important in Chlorophyll formation. Iron content in soils of Kota district ranges between 2.34 – 6.72 mg kg^{-1}. Soil samples from Ladpura block has medium Iron content whereas soil samples from Ramaganjmandi and Sangod block were found to be deficient in Iron. Fig. 2 shows the village-wise status of micronutrients.

Copper: Copper has important role in photosynthesis, protein and carbohydrate metabolism. Copper content in soils of Kota district was found in the range of 0.15 – 1.04 mg kg^{-1}. Copper in the soil is held with clay minerals as a cation and in association with organic matter. It is in excess amount in Ladpura Block while low to medium in Ramganjmandi and Sangod block.

Zinc: Zinc is component of many enzymes. It is essential for plant hormone balance, auxin activity and in seed development. Zinc content in soils of Kota district was found in the range of 0.30 – 1.27 mg kg^{-1}.It is found sufficient in Sangod and Ladpura block but deficient in Ramganjmandi block.

Manganese: Manganese is cofactor in many plants reactions and helps in activating enzymes. Manganese content in soils of Kota district was found deficient in all three blocks with the range of 2.24 – 2.61 mg kg^{-1}. The reason for manganese deficiency can be attributed due to high Organic matter content in soils and a near neutral pH above 6.5. The mean values of micronutrients in soils of Kota district are given in Table 5.

Table 2: Assessment of chemical properties of soil from different blocks of Kota district

Village Name	Soil pH		Electrical Conductivity (dS m^{-1})		Organic Carbon (%)	
	Range	Mean	Range	Mean	Range	Mean
Ramganjmandi						
Khairabad	7.64-7.69	7.71	0.17-0.28	0.22	0.24-0.48	0.38
Manda	7.64-7.75	7.70	0.19-0.3	0.24	0.5-0.96	0.76
Telya Kheri	7.92-8	7.97	0.23-0.3	0.27	0.28-0.4	0.33
Sangod						
Kolani	7.8-7.83	7.81	0.25-0.32	0.29	0.5-0.93	0.73
Bachhihera	7.67-7.75	7.70	0.37-0.47	0.41	0.46-0.9	0.70
Sawan Bhadon	7.67-7.8	7.75	0.21-0.33	0.27	0.36-0.91	0.70
Ladpura						
Dhakarkheri	7.51-7.68	7.60	0.29-0.38	0.34	0.24-0.4	0.33
Chareenda	7.66-7.78	7.71	0.17-0.24	0.20	0.16-0.45	0.29
Arampura	7.2-7.3	7.26	0.21-0.29	0.25	0.18-0.33	0.26

Table 3: Assessment of primary nutrients in soils from different blocks of Kota district

Village Name	Available Nitrogen (kg ha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
	Range	Mean	Range	Mean	Range	Mean
Ramganjmandi						
Khairabad	298.6-365.9	331.0	10.45-17.78	13.77	166.4-211.7	189.2
Manda	284.1-344.7	316.9	11.78-19.31	16.39	178.6-231.1	203.4
Telya Kheri	265.9-383.6	328.1	15.46-22.37	18.98	155.8-198.5	174.1
Sangod						
Kolani	330.1-376.3	349.7	17.45-24.34	20.64	187.1-267.7	224.4
Bachhihera	321.9-462.2	390.9	12.67-21.89	17.67	189.0-248.6	223.5
Sawan Bhadon	300.3-407.4	353.4	11.34-28.23	20.99	201.2-245.4	227.1
Ladpura						
Dhakarkheri	316.9-389.5	357.9	19.78-27.67	23.52	221.9-278.4	248.7
Chareenda	312.7-412.2	371.2	20.67-29.98	25.77	166.8-210.8	192.0
Arampura	280.7-380.3	328.1	19.89-29.34	25.33	218.2-244.0	225.3

Table 4: Assessment of secondary nutrients in soils from different blocks of Kota district

Village Name	Exchangeable Ca [cmol(p^+) kg^{-1}]		Exchangeable Mg [cmol(p^+) kg^{-1}]		Available Sulphur (kg ha^{-1})	
	Range	Mean	Range	Mean	Range	Mean
Ramganjmandi						
Khairabad	8-16.8	11.97	3.2-7.9	3.2	25.81-33.72	29.04
Manda	10.1-23	16.47	2.7-6.8	2.7	25.73-28.12	26.94
Telya Kheri	8.8-23.1	15.10	4.6-7.5	4.6	27.64-31.79	29.82
Sangod						
Kolani	9.4-18	13.20	1.5-6.5	3.9	26.12-30.89	28.12
Bachhihera	7.8-16.5	11.87	4.2-9.3	7.0	23.12-27.82	25.48
Sawan Bhadon	8.4-17.5	13.03	5.4-14.5	10.1	21.84-26.27	24.37
Ladpura						
Dhakarkheri	8.2-11.3	8.97	6.5-17.4	12.4	28.61-34.3	31.91
Chareenda	10.1-18.5	12.30	3.8-11.3	7.7	30.86-38.1	34.39
Arampura	7.3-14.5	10.57	6.4-15.1	10.9	30.12-31.9	30.65

Table 5: Assessment of micronutrients in soils from different blocks of Kota district

Village Name	Iron (ppm)	Copper (ppm)	Zinc (ppm)	Manganese (ppm)
	Mean	Mean	Mean	Mean
Ramganjmandi				
Khairabad	2.43	0.19	0.69	2.46
Manda	3.18	0.15	0.30	2.28
Telya Kheri	2.34	0.25	0.49	2.28
Sangod				
Kolani	2.47	0.56	0.71	2.24

Bachhihera	3.60	0.45	0.73	2.54
Sawan Bhadon	2.62	0.34	0.63	2.49
Ladpura				
Dhakarkheri	5.02	0.91	1.01	2.61
Chareenda	6.72	1.04	1.27	2.30
Arampura	5.56	0.85	1.05	2.46

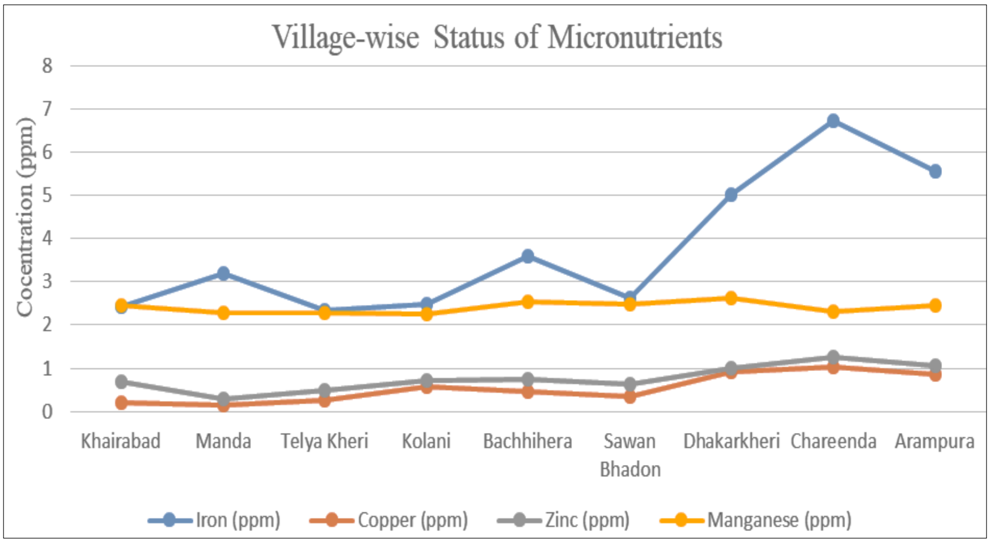

Fig 2: Graphical representation of Micronutrients Status in Soils of Kota district

Conclusion

The present study evaluated the Soil health parameters of Kota district. This investigation will help to recommend farmers to use proper and appropriate amount of fertilizer doses according to the requirement of the soil nutrients in their crop fields for better yield as well as to suggest an improved cropping pattern to the farmers. On the basis of analysis of different physico-chemical properties, this can be concluded that the Soil profile of the study area is nutrient efficient and do not require external nutrition. Due to unbalanced use of inorganic fertilizers by some farmers, a slightly high phosphorus content was found in Ladpura block. A customized set of soil management practices with no or minimal use of inorganic fertilizers and organic manures are suggested to such farmers.

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Conflict of Interest

As a Corresponding Author, I Mohammed Aasim, confirm that none of the others have any conflicts of interest associated with this publication.

References

1. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soils. Soil Sciences 1927;23:343-353.
2. Black CA. Methods of Soil Analysis Part – II. Chemical and microbiological properties. Agronomy Monograph No. 9. American Society of Agronomy, Inc. Madison, Wisconsin, USA 1965, 18-25.
3. Cheng KL, Bray RH. Determination of calcium and magnesium in soil and plant material. Soil Sci 1951;72:449-458.
4. Chesnin L, Yien CH. Turbidimetric determination of available sulphates. Proceedings of Soil Science Society of America 1950;14:149-51.
5. Das DK. Introductory Soil Science, 2nd Edition Kalyani Publishers, New Delhi 2004.
6. Doran JW, Parkin TB. Defining soil quality for a sustainable environment. Soil Science Society of America 1994, 35.
7. Jaiswal PC. Soil, plant and water analysis 2006, 72-132.
8. Jackson ML. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi 1973.
9. Lindsay WL, Norvell WA. Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J 1978;42:421-428.
10. Muthuval P, Udayasooriyan C, Natesan R, Ramaswami PR. Introduction to soil Analysis, Tamilnadu Agriculture University, Coimbatore-641002 1992.
11. Muhr GR, Datta NP, Shankara Subraney N, Dever F, Lecy VK, Donahue RR. Soil Testing in India, USAID Mission to India 1965.
12. Mourya S, Shaikh S, Mathur AK. Assessment of Physico-chemical properties of Irrigated soil in Kota city of Rajasthan, International Journal of Technical Research & Science 2016;1(5):61-64.
13. Nayak P, Nama KS, Choudhary K. Study on Soil Parameters of Selected Sites in Mukundara Hills National Park, Kota, Rajasthan, Int. J Pure App. Biosci 2016;4(4):316-320.
14. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA Circular 1954, 939.
15. Schoonover JE, Crim JF. An Introduction to Soil Concepts and the Role of Soils in Watershed Management. Journal of Contemporary Water Research & Education 2015;154(1):21-47.

16. Somasundaram J, Singh RK, Parandiyal AK, Prasad SN. Micronutrient status of soils under different land use systems in Chambal ravines. Journal of the Indian Society of Soil Science 2009, 57(3).
17. Siva Prasad PN, Subbarayappa CT, Reddy MR, Hari Mohan Meena. Development of Critical Limits for Different Crops Grown in Different Soils and Its use in Optimizing Fertilizer Rates. Int. J Curr. Microbiol. App. Sci 2017;6(6):241-249.
18. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in the soil, Current Science 1956;25:259-260.
19. Toth SJ, Prince AL. Estimation of Cation exchange capacity and exchangeable Ca, K and Na content of soil by Flame photometer technique. Soil Science An Interdisciplinary Approach to Soil Research 1949;67(6):439-446.
20. Walkley A, Black IA. An examination of the Degtjareff method for determiing soil organic matter and a proposed modification of the chromic acid titration method. Soil Science 1934;37:29-38.
21. Wilcox LV. Electrical conductivity. American Water Works Association J 1950;42:775-776.