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PHYSICO-CHEMICAL STUDY & EVALUATION OF SOIL HEALTH OF TODARAISINGHTEHSIL; TONK DIST. (RAJASTHAN)

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ABSTRACT

When assessing the quality of the soil, it is required to explain a comprehensive integration of static and dynamic chemical, physical and biological aspects. This is done in order to recognize diverse management and environmental scenarios. One of the key elements affecting crop yields is soil fertility and important soil components that affect soil fertility include macro- and micronutrients. A crucial component of sustainable agriculture production is soil characterization in relation to assessing the fertility status of soil of a region. Assessing the soil quality is crucial for determining the best management strategies to use for sustainable crop production. This study focused on some selected soil chemical parameters in a few blocks of Tonk district of Rajasthan state. It was observed that pH and Electrical Conductivity optimum, compared to the standard values provided by ICAR in various soil samples collected; While Organic Carbon, Phosphorus & Potassium were found to be below optimum values. Similarly Sulphur & Iron were found to be almost optimum and Zn, Mn & Cu were found to be above optimum values in most of the samples. Thus for better production of various crops, grown in this region like jowar, millet, wheat, groundnut and mustard, the soil can be improved with the recommendations of suitable fertilizers and organic manures.

Keywords: Mineral Nutrients, Soil Health, Crop Improvement, Sustainable Farming.

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1. INTRODUCTION

Soils are very rich in nutrients and they are natural filters to remove the contaminants from the water. On the other hand, soils may contain many heavy metals and pathogens that may have negative impact on human health. India is the land of agriculture and food security is achieved when all people have sufficient, safe and nutritious food which completely depends on the soil health (Brevik 2013; Carvalho 2006)[2,3]. The soil with sufficient organic matter, well developed structure, good physical and chemical characters can promote crop growth which leads to strong yields which is important for food security (Reicosky *et al.* 2011; Brevik 2009)[8,1]. Because soil has the ability to resist (or be resilient) to the impacts of potentially harmful conditions or usage, as well as to filter out toxic items put to it, changes in external conditions or use may not always result in changes to the soil system. One of the most vital industries supporting human life is agriculture. Assessment of prospective land use will probably result in a prediction of the sort of productive land use that is possible. (Dadhwal et al., 2011)[4]. Without taking into account the unpredictability of the overall production

system, agricultural intensification and enormous infrastructural expansion in recent years have increased the danger of soil erosion and fertility loss. (Singh et al., 2007)[9]. One of the most crucial components of soil is organic matter, which increases soil fertility when there is a sufficient amount present. Depletion of organic carbon, soil micronutrients, and soil macronutrients, erosion-caused loss of topsoil, altered physical characteristics, and increased soil salinity are the main land use restrictions. (Kumar et al., 2017)[7]. The present study is aimed to investigate the soil quality of selected Todaraisingh block of Tonk district through collection of samples and their analysis for different soil parameters.

2. STUDY AREA

The study is conducted during the session of 2022-23 at Todaraisingh Block of Tonk district under Ajmer division of Rajasthan state. It is a rural area situated near the Banas river at 26º01'26" N latitudes and 75°29'02" E longitude of Rajasthan state. It is located 42 KM towards west from District head quarter. Todaraisingh is surrounded by Deoli Tehsil towards South, Tonk Tehsil towards East, Kekri Tehsil towards west and Malpura Tehsil towards North.

This region is quite unique because of its historical, cultural and geographical heritage. The climate of that area is dry or semi humid. The black cotton growing soils are significantly recorded in the vast portion of the area. It is supposed to be suitable for oil yielding crops, as these have got a favourable character of moisture retention for oil yielding plants. As of 2011 India census, Todaraisingh has a population of 146,870. Most of it depends on agriculture. Here, crops like pearl millet, sorghum, wheat, groundnut and mustard etc. are grown throughout the year. The crop cycle here is mainly based on monsoon, but the percentage of agriculture based on ground water irrigation is continuously increasing since last decade.

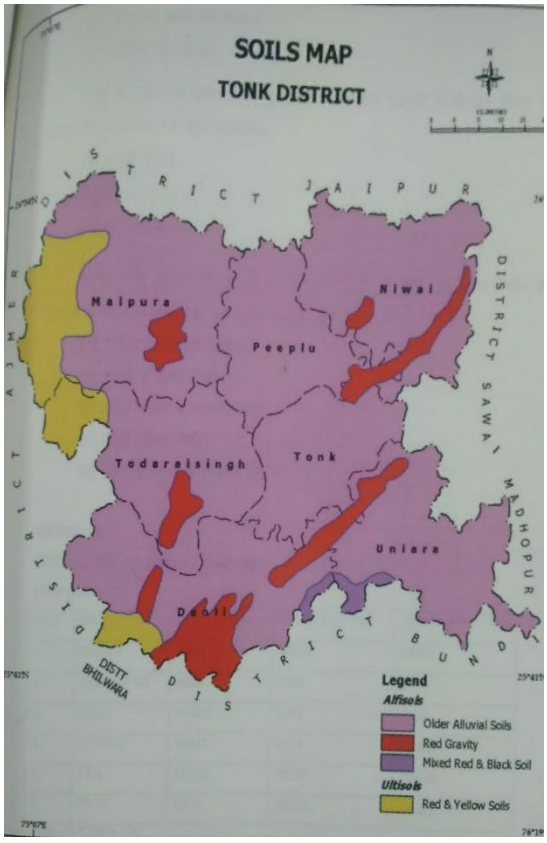

Fig.1: Soil Map of Tonk District

3. METHODOLOGY

1. COLLECTION OF SOIL SAMPLES-

Some farmer's fields were selected for the present investigation due to their predominance and wide spread sowing in that area. 4 kg. soil was also collected from each of the field.

2. PHYSICAL AND CHEMICAL ANALYSIS OF SOIL:

Physical, physico-chemical and chemical tests like- texture, pH (soil response), electrical conductivity, mineralisable nitrogen, accessible phosphorus and potassium determination are frequently performed in soil testing. While other soil characteristics are determined quantitatively in order to make appropriate recommendations for the use of fertilizers and/or amendments, only a qualitative assessment of the free calcium carbonate content (in the case of neutral to alkaline soil) and of soil texture is typically made, unless specifically required otherwise.

I. SOIL pH: The aqueous suspension of soil (5:1 V/W) was used to determine the soil pH with digital pH meter.

II. ELECTRICAL CONDUCTIVITY: EC is a measure of the concentration of soluble salts in the soil at any particular temperature. [Dhyan Singh et. al (1999)] [5].

III. SOIL ORGANIC CARBON- The organic carbon in the soil was estimated on percentage basis by Walkey and Black (1934)[10].

III. SOIL NITROGEN- Nitrogen in the soil sample was estimated by Microkjeldhal method.

IV. SOIL PHOSPHORUS- The soil phosphorus was estimated by Vanadomolydate method of Jackson (1971)[6] for the preparation of standard curve.

V. SOIL POTASSIUM- Potassium in soil exists as water soluble, exchangeable, non-exchangeable (fixed) and lattice-K. The first two forms constitute only a small part, normally not more than one percent of the total content and are considered to be easily available to plants.

VI. MICROELEMENTS- Because of the extremely small quantities needed by plants, soil testing for Micro-elements, namely Cu, Fe, Zn, Mn, B, Cl and Mo was of little concern till few decades back. Only in rare cases, the necessity of assessing their availability was felt. Now the deficiency of a few of them (*e.g.* Zn, Fe, Mn and B) has appeared in certain areas mainly due to the use of high analysis inorganic fertilizers, little or no use of organic manures and heavy removal by high yielding crop cultivars.

4. OBSERVATIONS AND RESULTS:

The following observations were received for the soil samples collected from different places of Todaraisingh area:

Table: 1 Observed Values of Different Soil Parameters in Collected Samples

S.No.	Soil Parameters	Unit	Value observed				
			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1	pH		7.50	7.60	7.50	7.50	7.60
2	Electrical Conductivity	DS/M	0.16	0.18	0.20	0.24	0.18
3	Organic Carbon (OC)	%	0.36	0.40	0.44	0.45	0.48
4	Available Nitrogen (N)	kg/ha.	0.031	0.0344	0.0379	0.0387	0.0413
5	Available Phosphorus (P)	kg/ha.	36.00	40.00	50.00	55.00	48.00
6	Available Potassium (K)	kg/ha.	310.00	316.00	300.00	360.00	290.00
7	Available Sulphur (S)	PPM	10.00	14.00	14.00	12.00	10.00
8	Available Zinc (Zn)	PPM	0.36	0.66	0.90	0.90	0.40
9	Available Iron (Fe)	PPM	4.00	5.00	4.90	4.80	3.40
10	Available Manganese (Mn)	PPM	2.40	2.80	3.00	3.00	2.80
11	Available Copper (Cu)	PPM	0.36	0.40	0.50	0.50	0.46

A variety of physico-chemical properties, available macronutrients and nutrients that could be applied to fields using inorganic fertilizers like manure and organic manure and the health of crop plants that were obtained from both organic and inorganic fields were all evaluated in the current study, which aimed to evaluate the quality and health of soil samples that were taken from individual fields in five villages in the Todaraisingh tehsil of Tonk district. The results of physical and chemical analysis of soil samples are depicted in Table-1 & displayed in Fig.2-6. From table-1 it is evident that the maximum soil pH is 7.60 in sample 2 and 5, while it is 7.50 in sample 1, 3 and 4. In case of Electrical Conductivity, the highest value of 0.24 DS/M was obtained for sample 4, followed by 0.20 DS/M for sample 3, then 0.18 DS/M for sample 2 and 5 and minimum 0.16 DS/M for sample 1. Decreasing values of Organic Carbon % were obtained for sample 5 (0.48%); sample 4 (0.45%); sample 3 (0.44%); sample 2 (0.40%) and sample 1 (0.36%) respectively.

The highest value of available Nitrogen was observed in sample 5(0.0413 kg/hac.) and minimum in sample 1 that was 0.03 kg/hac. The highest value of available Phosphorus was found for sample 4 (55.00 kg/ha.) followed by sample 3 (50.00 kg/ha.), sample 5 (48.00 kg/ha.), sample 2 (40.00 kg/ha.) and minimum for sample 1 (36.00 kg/ha.) respectively.

The highest available Potassium was found to be 360 kh/ha. for sample 4; followed by 316 kg/ha. for sample 2, 310 kg/ha. for sample 1; 300 kg/ha. for sample 3 and the lowest value was 290 kg/ha. for sample 5.

The maximum value for available Sulphur (S) was obtained for sample-2 and 3 at 14.00 PPM, while for sample 4 12.00 PPM and for sample 1 and 5 it was minimum at 10.00 PPM. The highest amount of available Zinc (Zn) in sample 3 and 4 was 0.90 PPM; The minimum was found in sample 1 at 0.36 PPM, while in between, 0.66 PPM was found in sample 2 and 0.40 PPM in sample 5. The highest value of available Iron (Fe) was found for sample 2 (5.00 PPM) followed by sample 3 (4.90 PPM), then for sample 4 it was 4.80 PPM and 4.00 PPM for sample 1, minimum value was obtained for simple 5 (3.40 PPM). The maximum value for available Manganese (Mn) was obtained for sample 3 and 4 at 3.00 PPM, while for sample 2 and 5 it was 2.80 and for sample 1, it was minimum at 2.40 PPM. The highest available Copper (Cu) was found to be 0.50 PPM for sample 3 and 4; which is followed by 0.46 PPM in sample 5; 0.40 PPM for sample 2 and the lowest value was 0.36 for sample 1.

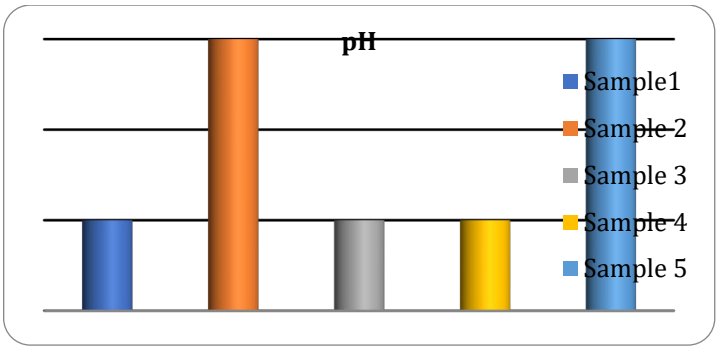

Fig.2: pH variations in different soil samples

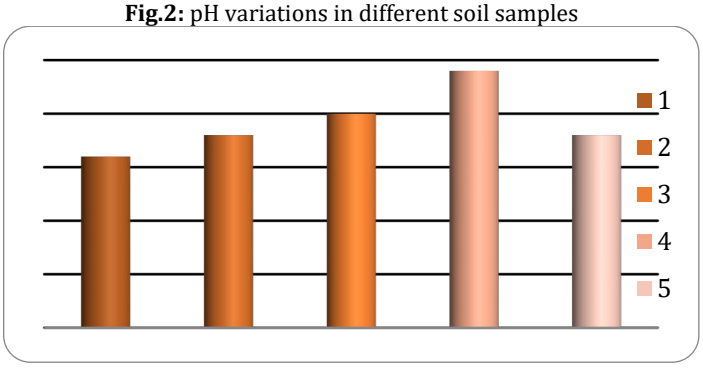

Fig.3: Electrical Conductivity variations in different soil samples

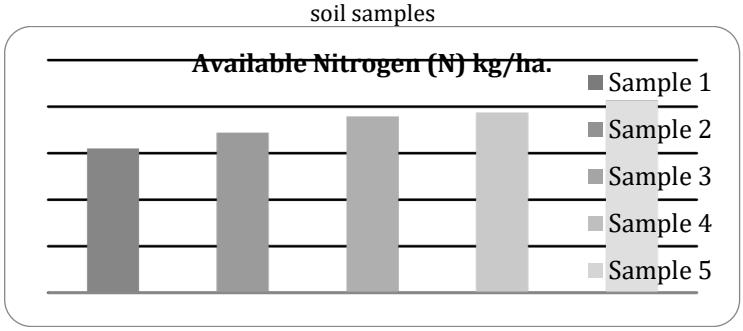

Fig.4: Available Nitrogen levels in different soil samples

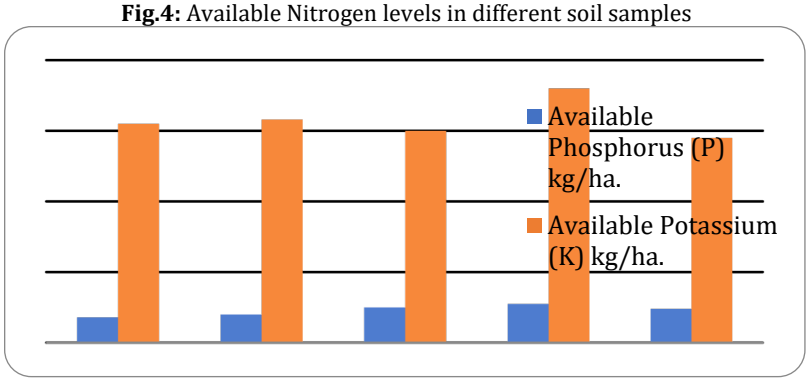

Fig.5: Available P and K levels in different soil samples

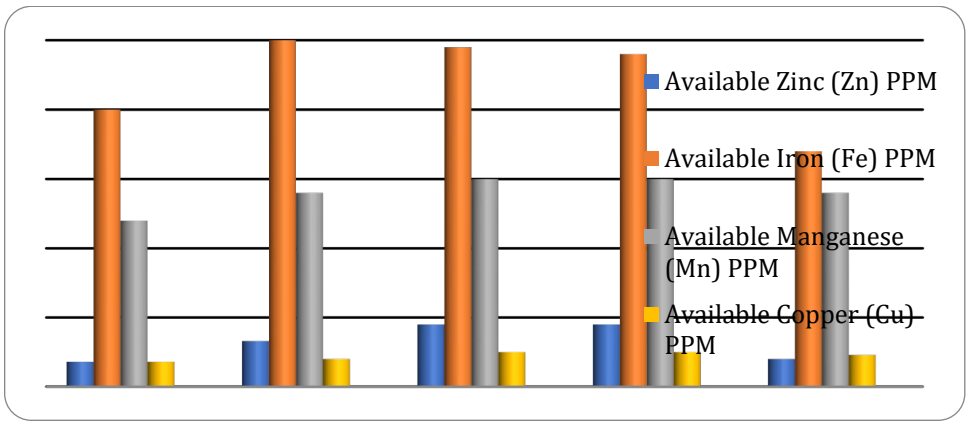

Fig. 6: Availability of Micronutrients in different soil samples

The following optimum levels/values of various soil elements have been prescribed by ICAR (as given in table 2):

Table: 2 Soil Properties and Optimum Level of Soil Elements

S.No.	Soil Properties	Optimum Level
1	pH	between 7.0-8.5
2	EC (DS/M)	till 1.5
Major Soil Nutrients		
1	Organic Carbon	more than 0.75
2	Available P (kg/ha.)	more than 56.0
3	Available K (kg/ha.)	more than 336.0
Secondary & Minor Soil Nutrients		
1	Sulphur (PPM)	10.0 or more
2	Zinc (PPM)	0.6 or more
3	Boron (PPM)	0.5 or more
4	Iron (PPM)	4.5 or more
5	Manganese (PPM)	2.0 or more
6	Copper (PPM)	0.2 or more

Based on Table 2, the following conclusions are drawn for various parameters for the collected soil samples obtained in Table 1:

pH and Electrical Conductivity are optimum, compared to the standard values provided by ICAR in various soil samples collected; While Organic Carbon, Phosphorus & Potassium were found to be below optimum values. Similarly Sulphur & Iron were found to be almost optimum and Zinc, Manganese & Copper were found to be above optimum values in most of the samples.

5. CONCLUSION

Although the soil samples collected from the study area which are less or more than the suggested optimum level of elements can be full-filled by adding the required quantities. But, panchayat Samiti Todaraisingh is classified under sensitive (dark) category. In the year 1984, only 38% of the available ground water was used every year, but now 92% is being exploited. In 1984, water available was at an average depth of 9 m., which is now increased to 15 m. These figures show that if ground water exploitation continues at this pace, the cultivated soil of the selected study area will soon become completely barren. On which any type of fertilizer or manure will not be affected and the entire agricultural system will be destroyed. Therefore, considering the irregularities of various mineral nutrients in the soil, organic farming seems to be the best solution.

6. RECOMMENDATIONS

- The pH of the soil is alkaline in almost all the studied samples, which may make some nutrients less available.
- Low levels of organic carbon and organic matter suggest possible fertility problems and the need for additions to enhance soil health.

- Low salinity is suggested by electrical conductivity, which is beneficial. To increase the amounts of organic carbon and organic matter in the soil, think about adding compost or other organic materials as soil supplements. To guarantee ideal circumstances for plant growth, pH and nutrient levels should be regularly monitored. Examine the possibility of choosing crops that can survive in an alkaline environment.
- The extremely low quantities of nitrogen could have a major effect on plant development. In order to remedy this shortcoming, remediation techniques are necessary. To raise the nitrogen content of the soil, add organic amendments (such as legumes) or fertilizers high in nitrogen. Cover crops or crop rotation can also be used.
- High amounts of potassium and phosphorus are beneficial for crop productivity. These nutrients are necessary for the healthy development of plants. P and K levels should be regularly checked to make sure they stay suitable for crops. To prevent any possible nutritional imbalances, use balanced fertilization techniques.
- The optimal levels of copper, zinc, and manganese improve the general health of the plant. Iron levels are rather elevated, which could be dangerous; close observation is advised to avoid any possible toxicity.

CONFLICT OF INTERESTS

None.

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None.

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