

Study of Basic Soil Properties in Relation with Micronutrients of Mandvi Tahsil near Coastal Region of Kutch District

Prakash L. Patel^{1,2}, Nirmal P. Patel^{1,2}, Prakash H. Patel^{1,2}, Anita Gharekhan¹

¹C. U. Shah Science College, Physics department, Ashram road, Ahmedabad-380014, Gujarat, India

²Research scholar, Pacific University (PAHER), Udaipur, Rajasthan, India

Abstract: This paper presents the study of agricultural soil of Mandvi tahsil of Kutch district located near coastal region. Total 2531 samples were collected from different eighteen sites. Under the soil health card programme of Government of Gujarat, all soil samples were collected by trained farmers and brought for analysis to Soil Test laboratory of Bhuj. All soil samples were analyzed for pH, Electrical conductivity, Phosphorus, Potassium, Organic Carbon, Iron, Copper, Zinc, Manganese, Calcium, Magnesium and Sulfur. The aim of this paper is to study soil fertility status and correlation of basic soil properties with micronutrients. This study concludes that the 'correlation analysis' and discriminate analysis can provide scientific basis for monitoring and controlling the tillage management.

Keywords: Fertility management, Kutch, Mandvi, Micronutrients, Soil fertility

1. Introduction

Healthy soil is basic component of the modern and scientific tillage so that it is necessary to determine the fundamental needs of soil. To determine the growth of crop, soil fertility is an important factors and which determine by presence or absence of soil parameters namely pH, EC, C, P, K, Fe, Mn, Cu, Zn, Ca, Mg, and S. Application of statistical tools can provide such information and assist the interpretation of soil tested data [1]-[2].

The aim of this paper is:

- To study and analysis of soil properties by the application of selected statistical tools.
- Agricultural soil study through correlation of basic soil properties (pH and EC) with micronutrients (Fe, Cu, Mn and Zn).

In this work, Pearson's correlation analysis is used to study 2031 medium black soil samples from 18 sites of Mandvi tahsil in kutch district [3]-[8].

2. Material and Methods

2.1 The study Area

In this work the study area is agricultural soil of different site of Mandvi tahsil near coastal region of Kutch district. Kutch is a district of Gujarat state in Western India, covering an area of 45652 km². [9] It is one of the largest district in India. The district lies in the extreme west of india between 22°44' to 24°41' North latitude, 68°7' to 71°46' East longitude [10]. Maximum and minimum temperature range is 45°C to 4°C. Average rainfall is 587mm. Kutch is virtually an island, as it is surrounded by the Arabian Sea in the west, by the Gulf of Kutch in south and southeast by Dessert of Kutch in north and northeast. Mandvi tahsil is the study area which is

located near costal part. Kutch district was struck by major earthquake on 26 January 2001. In this area major soils are medium black, sandy, and hydromorphic type. [11]

Major Field crops are Groundnut, Bajra, Castor, Greengram, Wheat, Cotton, Mothbean, Mung and major hostricultural crops are Mango, Papaya, Cucurbits, Sapota, Babana [12]. From the collected data at different science colleges and STL under soil health card program by the government of Gujarat, India, we have selected 2531 medium black soil samples based on different crops from different site of Mandvi tahsil for this study. Locations of study area and samples sits are shown in figure 1.

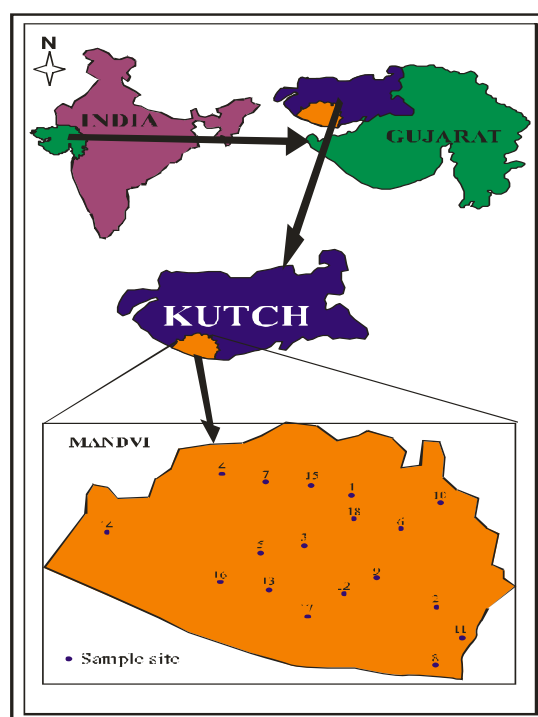


Figure 1: Location map of study area, Mandvi tahsil of kutch district, Gujarat, India

2.2 Soil Sampling and Analysis

Soil samples were collected by systematic sampling method at 0 to 20 cm depth below the surface. The samples were dried and passed through a 2 mm sieve to prepare them for testing. Using standard methods all the samples were tested by following “Methods manual- Soil testing of India” [13].

All the samples were tested and analyzed for soil properties. Same study was reported for other location by M.Kumar [14] and Wajahat Nazif [15]. Sample site detail and total sample samples, crops, soil surface and types are shown in table 1.

Table 1: Samples site, Total samples, Running crope, soil surface and soil type

Sample site No	Samples Site	Total Samples	Crope
1	Jamthada	30	Mung
2	Bidada	30	Groundnut
3	Bhadaimoti	30	Mung
4	Mau moti	30	Groundnut
5	Ratadiyamota	299	Groundnut
6	Kojachora	30	Castor
7	Gadhshisa	30	Cotton
8	Tragadi	30	Cotton
9	Talvana	552	Cotton
10	Punadi	30	Cotton
11	Motabhadiya	30	Cotton
12	Rayan moti	30	Cotton
13	Vada	30	Castor
14	Dedhiya	359	Castor
15	Bheraiya	30	Castor
16	Motalayaja	466	Castor
17	Godhara	465	Cotton
18	Mamaymota	30	Mung

Soil Surface: Plane and Soil Type: Medium black

2.3 Tools and Technique

A Pearson’s correlation analysis is used to confirm the relationship among basic soil properties (pH and EC) and Micronutrients (Fe, Cu, Mn and Zn) [16]. Total 2531 samples are considered for study and analysis. After treating outliers Maximum, Minimum, Mean, Median, Mode and Standard deviation are calculated for soil parameters. EXCEL and MATLAB are used to perform all statistical analysis

3. Result and Discussion

Selected soil parameters (pH, EC, C, P, K, Fe, Cu, Mn, Zn, Ca, Mg and S) descriptive statistics are shown in table 2, and Description of soil properties is shown in table 3. Study and determination of all soil parameters followed by standard methods [13], [17]-[18]. Critical limit of soil parameters is shown in table 4.

Table 2: Descriptive statistics of the distribution of soil parameters of Mandvi tehsil

Sr.N	Soilparamete	Minimum	Maximum	Mean
1	pH	6.2	9.9	7.5
2	EC	0.1	2.32	0.34
3	C	0.05	63	0.97
4	P	0.2	898	44.84
5	K	21	6321	351.97
6	Fe	1	5.2	2.81
7	Cu	0.2	0.8	0.39
8	Mn	2	8	4.65
9	Zn	0.2	8	4.56
10	Ca	7	15.4	11.62
11	Mg	2	8.5	5.28
12	S	22.32	49.6	35.99

Sr.No	Soil parameter	Median	Mode	Standard deviation
1	pH	7.5	7.5	0.38
2	EC	0.25	0.25	0.16
3	C	0.52	0.52	4.26
4	P	41	25	42.36
5	K	325	235	286.76
6	Fe	2.5	2.5	1.09
7	Cu	0.36	0.25	0.14
8	Mn	4.5	4.5	1.46
9	Zn	4.5	4.5	1.9
10	Ca	12.4	14.2	2.6
11	Mg	5.2	4.5	1.49
12	S	35	34.72	6.28

Table 3: Description of soil properties

Sr.No	Soil properties	Description
1	pH	pH value of Agriculture Soil
2	EC	Electrical Conductivity, dS/m
3	C	Organic carbon, %
4	P	Phosphosous, Kg/ha
5	K	Potassium,, Kg/ha
6	Fe	Iron, ppm
7	Cu	Copper, ppm
8	Mn	Mangnese, ppm
9	Zn	Zinc, ppm
10	Ca	Calcium, Meq/100gm
11	Mg	Magnesium, Meq/100gm
12	S	Sulfur, ppm

Table 4: Critical limit of Soil properties (followed by MMSOIL-Gov. of India-2011)

Parameters	Interpretation	
pH	< 4.6	Extremely acidic
	4.6 - 5.5	Strongly acidic
	5.6 - 6.5	Moderately acidic
	6.6 - 6.9	Slightly acidic
	7	Neutral
	7.1 - 8.5	Moderately alkaline
EC dS/m	>8.5	Strongly alkaline
	0 - 2	Salt Free
	4 - 8	Slightly Saline
	8 - 15	Moderately Saline
OC %	> 15	Highly Saline
	<0.5	Low
	0.5- 0.75	Medium
P Kg/ha	> 0.75	High
	< 10.0	Low
	10 - 24.6	Medium
K Kg/ha	> 24.6	High
	< 108	Low
	108- 280	Medium
Fe ppm	> 280	High
	0.0 - 2.0	Very Low
	2.0 - 4.0	Low
	4.0 - 6.0	Medium
	6.0 - 10	High
Cu ppm	> 10	Very High
	0.0 - 0.1	Very Low
	0.1 - 0.3	Low
	0.3 - 0.8	Medium
	0.8 - 3	High
Zn ppm	> 3.0	Very High
	0.0 - 0.5	Very Low
	0.5 - 1.0	Low
	1.0 - 3.0	Medium
	3.0 - 5.0	High
Mn ppm	> 5.0	Very High
	0.0 - 0.5	Very Low
	0.5 - 1.2	Low
	1.2 - 3.5	Medium
	3.5 - 6	High
Ca Meq/100gm	6.0 to 18.0	
Mg Meq/100gm	2.0 to 10.0	
S %	8 to 10	

Looking to critical limit table 4, and descriptive statistics observation, it shows that the soils are slightly acidic to moderately alkaline in reaction with pH (6.20-9.90) and mean value 7.5. High pH might be due to the presence of high degree of base saturation. Major soils shows around neutral pH from the median and mode. The electrical conductivity (EC) is varied from 0.1 to 2.32 dSm⁻¹ with mean 0.34 dSm⁻¹ and median 0.25 dSm⁻¹ As compare to mean, median and mode, it shows that most of soil samples are in salt free range. Organic Carbon (OC) of the soil varied from 0.5 to 63% with mean, median and mode 0.97 % , 0.52 % and 0.52 %. Phosphorus (P) content of soil is minimum 0.2 and maximum 898 Kg/ha with mean value 44.84 and Potassium(K) content of soil is minimum 21 Kg/ha and maximum 6321 Kg/ha with mean value 351 Kg/ha. Here this study area's soil range of P and K are considerable large and which might be due to variation in other soil properties and fertilizer practice. Sulfur content range 22.32ppm - 49.60ppm

with mean and median 35.99ppm and 35.00ppm. Observation of Calcium (Ca) and Magnesium (Mg) are shows range 7.00 to 15.40 Meq/100gm and 2.0 to 8.5 Meq/100gm respectively. This is normal in range of agriculture soil.

The available Iron (Fe) content of the soils is minimum 1 and maximum 5.2 ppm with mean value 2.81. As per reference of critical limit the study area appeared to be quite sufficient in available Fe. The available Copper (Cu) content of the soils is minimum 0.20 ppm and maximum 0.8 ppm with mean value 0.39 ppm.

Here available Cu is quite sufficient in all samples. The available Zinc (Zn) varied from 0.2 to 8.0 ppm with mean value 4.56. On the bases of critical limit, it shows high value of Zn in some samples this might be due to changing in other soil properties like pH. The available Manganese (Mn) content of soils is minimum 2.0 to 8.0 ppm with mean value 4.65 and median 4.5. The study area appears to sufficient in Mn.

3.1 Relation of basic soil properties (pH and EC) with micronutrients (Fe, Cu, Zn and Mn) :

Correlation coefficients (r) is shown in table 5.

Table 6: Correlations Coefficients (r) of basic soil properties and micronutrients.

soil parameter	Correlations Coefficients (r)
pH - EC	0.0235
pH - Fe	-0.0001
pH - Cu	0.0276
pH - Mn	-0.0053
pH - Zn	0.0123
EC - Fe	-0.0169
EC - Cu	-0.026
EC - Zn	-0.0362
EC - Mn	-0.028

The available Cu (r=-0.0260), Fe (r=-0.0169), Zn (r=-0.0362) and Mn (r=-0.0280) inversely proportional to EC. The availability of Zn (r= 0.0123) and Cu (r= 0.0276) increased with increase in pH. Here positive but not very significant correlation between pH with Zn and Cu. Less negative correlation of pH is found with Fe (r=-0.0001) and Mn (r=-0.0053).

4. Conclusion

1. Observation shows negative correlation of EC with all (Fe, Cu, Mn, Zn) micronutrients.
2. Present Study shows that the major study area is free from salt.
3. Very high value of Sulfur indicates use of intensive agriculture practices.
4. EC and pH of study area are fairly good for agriculture.
5. Present study concludes that statistical methods e.g. correlation analysis can provide a scientific basis for controlling and monitoring agriculture soil fertility management.

5. Future Scope

In present work and most study of this kind was performed for horizontal soil properties distribution but there is also necessary to know the vertical distribution of soil parameters.

References

- [1] M.M Sena, R.T.S. Frighetto, P.J. Valarini, H. Tokeshi and R.J. Poppi, 2002. "Discrimination of management effects on soil parameters by using principal component analysis: A multivariate analysis case study. Soil and Tillage Research," 67: 171-181.
- [2] J. W. Einax and U. Soldt, 1999. "Geostatistical and multivariate statistical method for the assessment of polluted soils; Merits and limitations," Chemometrics Intell. Lab., 46: 79-91.
- [3] P. L. Patel, Nirmal P. Patel, Prakash H. Patel, and Anita Gharekhan. "Correlation study of Soil Parameter of Kutch district Agriculture land," International Journal of Scientific and Research Publications 2014, Volume-IV, Issue-V, p:2989.
- [4] R. Vijayakumar, A. Arokiaraj, D.P. Martin. "Micronutrients and their Relationship with Soil Properties of Natural Disaster Prone Coastal Soils," Res J Chem Sci. 2011;1(1):8-12
- [5] C. Mico, Recatala L, Peris M, Sanchez J. "Assessing heavy metal sources in agricultural soil of an European Mediteranean area by multivariate analysis," Chemosphere 2006;65:863-72
- [6] V. S. Mali, N. A. Zende, U. K. Verma. "Correlation between soil physic-chemical properties and available micronutrients in salt effected soils," 17th WCSS 2002;Thailand
- [7] A. Gharekhan, A. N. Oza, M.B. Sureshkumar, A. Pradhan, P. K. Panigrahi, "Study of polarized spectral features of human breast tissues through wavelet transform and principal component analysis," Pramana - Journal of Physics 2010;75(6):1281-6
- [8] A. Gharekhan, S. Arora, et al. "Distinguishing auto-fluorescence of Normal, Benign and Cancerous Breast Tissues through Wavelet Domain Correlation Studies," Journal of Biomedical Optics 2011;16(8):087003 Also published in Virtual Journal of Biological Physics Research 2011;22(4)
- [9] Kutch. vibrantgujarat.com
- [10] www.indianetzone.com
- [11] Soils of Gujarat - <http://goo.gl/CF9Rb>
- [12] Agriculture Contingency Plan for District, Kutch, Gujarat.
- [13] "Methods Manual-Soil Testing in India", Department of Agriculture & Cooperation Ministry of Agriculture Government of India 2011
- [14] M. Kumar and A. L. Babel, "Journal of Agricultural Science" 2011,3,97-106
- [15] W. Nazif, Sjida Perveen and Iftikhar Saleem, Journal of Agricultural and Biological Science"2006,1,35.
- [16] V. G. Panse and P.V. Sukhatme, 2000. "stistical methods for agricultural workers." ICAR, New Delhi, pp:359

- [17] M. L. Jackson, Soil chemical Analysis, First Edn. Prentice Hall of India Pvt. Ltd., New Delhi, India,1973.
- [18] N.C.Brady , The Nature and properties of Soils, 9. Macmilla Publishing Co., New York, 1984, p.750.

Author Profile

Prakash L. Patel received the B.Sc. and M.Sc. degrees in Physics subject from Sardar Patel University, Vallabh Vidyanagar, Gujarat in 1987 and 1989, respectively. At present working as a Associate Professor in Physics at C. U. Shah Science College, Gujarat University, Ahmedabad, India

Nirmal P. Patel received the B.Sc. and M.Sc. degrees in Physics subject from Gujarat University, Ahmedabad, Gujarat. At present working as a Associate Professor in Physics at C. U. Shah Science College, Gujarat University, Ahmedabad, India

Prakash H. Patel received the B.Sc. and M.Sc. degrees in Physics subject from Gujarat University, Ahmedabad. Gujarat. At present working as a Associate Professor in Physics at C. U. Shah Science College, Gujarat University, Ahmedabad, India

Anita Gharekhan received the B.Sc., M.Sc. and M.Phil degrees in Physics subject from Gujarat University, Ahmedabad, Gujarat and received Ph.D. degree in physics from M.S. University Baroda. At present working as a Associate Professor in Physics and as I/C Principal at C. U. Shah Science College, Gujarat University, Ahmedabad, India