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RESEARCH PAPER

Major-nutrients status in soils of Kachahh district of Gujarat

J. P. Chaudhary, A.H. Sipai*, P. P. Chaudhary **and** I.D. Vaghela
Department of Agricultural Chemistry and Soil Science, C.P. College of Agriculture, S.D. Agricultural University, SARDARKRUSHINAGAR (GUJARAT) INDIA (Email : Sipaisoil@gmail.com)

Abstract : A study was undertaken to assess the status of available major nutrients in soils of Kachchh district of Gujarat. About Forty representative surface (0-15 cm) soil samples were collected from farmer's field of each taluka. The soil samples were analysed for pH, EC, organic carbon, available N, P_2O_5 and K_2O. Soils of Kachchh district are mildly alkaline to moderately alkaline in reaction ($pH_{2.5}$ 8.14) with low soluble salt content (EC 0.57 dS/m).The organic carbon status of soils of Kachchh district was low (0.35 %). The available N, P_2O_5 and K_2O content in these soils ranged from 62.72 to 392.00, 16.81 to 116.58 and 107.52 to 954.24 kg/ha with a mean value of 193.93, 41.85 and 330.86 kg/ha, respectively. On the basis of nutrient index value, soils of Kachchh district were very low in available nitrogen, marginal in available phosphorus and high in available potassium status. Highly significant and positive correlation was observed between organic carbon with available nitrogen (r = 0.842**). Available P_2O_5 showed negative correlation with pH (r = -0.066) and EC (r = -0.011). Available N (r = 0.178**) and O.C. (r = 0.193**) have highly significantly and positively correlation with pH.

Key Words : Major-nutrients, Status in soils, N, P_2O_5 , K_2O, pH

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INTRODUCTION

Soil, a non-renewable natural resource essential for all forms of life is a major concern for safety. It has been nurturing every living form directly or indirectly since, the evolution of life forms on planet earth. The soil is one such natural resource that requires constant attention for maintaining its fertility and productivity. Proper management of soil fertility demands careful identification of constraints of current nutrient deficiencies and build up with monitoring changes in soil fertility to ensure continued high productivity in the future and it also act as a one or the key component to determine the state of the soil health. It plays an important role in plant metabolism by virtue of being an essential constituent of structural component of the cell and many metabolically active compounds. It is also a constituent of chlorophyll. Phosphorus plays a pivotal structure and regulatory role at the nexus of photosynthesis, root development, energy conservation, transformations, carbon metabolism, redox reactions, enzyme activation/inactivation, signaling and nucleic acid synthesis (Vance

*** Author for correspondence:**

et al., 2003). Potassium is well known for its ability to improve crop quality and its role in combating a variety of climatic and biological stress.

MATERIAL AND METHODS

The present investigation was carried out to assess macronutrients status of the soils of Kachchh district. Kachchh is a largest district (45,652 km^2) of Gujarat state. It lies at 22°44'11" to 24°41'25" North Latitude and 68° 09'46" to 71°54'47" East Longitude. It's an arid district of Gujarat covering 73 per cent of the total geographical area of the arid region of this state. Soils of Kachchh are low water holding capacity, poor fertility, erosive, low to medium nutrients status, undulating topography and soil salinity/alkalinity. Similar to the inland talukas, annual rainfall in the seven coastal talukas of Kachchh is also poor, ranging from 250-350 mm and is often irregular. Mean rainfall (1932 to 2001) was highest at Mundra (407 mm) while Mandvi and Abadasa talukas recorded a mean rainfall of 387 and 378 mm, respectively, for this period. Winter and summer temperature range from 7 to 48°C with an average humidity of 60 per cent /year which is increase to 80 per cent during south-west monsoon and decrease to 50 per cent during November-December. Average wind speed is 4.65 km/hr /year with a maximum wind speed of 10.61 km/hr during June. The phenomenon of drought is common with 2 drought year in a cycle of 5 years. As a characteristic of arid zone, annual temperature fluctuation in the district is extreme, ranging from 4°C to 48.5^{0}C. To assess the available nitrogen, phosphorus and potassium in soils of Kachchh district, total 400 representative surface soil samples were collected from farmer's fields of each taluka of Kachchh district during 2016. One representative surface sample was collected from field upto a depth of 0 to 20 cm by multistage stratified random sampling method (Singh *et al*., 1982). All the composite soil samples were air-dried, ground and passed through 2 mm sieve for chemical analysis. All the samples were stored in the polythene bags for further analysis. Soil pH and electrical conductivity (EC) were determined by potentiometery and direct reading conductivity meter using 1: 2.5 soil water suspensions (Jackson, 1973). The composite soil samples were analyzed for available nitrogen (Subbiah and Asija, 1956), available P_2O_5 Olsen *et al.* (1954), neutral ammonium acetate extractable K_2O (Jackson, 1973), organic carbon (Walkley and Black, 1934). The relationship between various soil properties and macro-nutrients distribution were established by using simple correlation co-efficient.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

Chemical characteristics of soil :

Forty surface soils (0 to 20 cm) of Kachchh district were analyzed. The results of soil pH, and EC represented in Table 1 and 2, respectively.

Soil reaction ($pH_{2.5}$):

In general, the soils of this district are moderately alkaline to very strong alkaline in reaction. The pH values of the soils for the entire district were ranging from 6.90 to 9.60 with a mean value of 8.14. The lowest mean pH

Table 1: Measured pH of collected soil samples

Sr. No.	pH value	No.of soil samples	% of samples
1.	6.6-7.3	7	1.75
2.	7.4-7.8	41	10.25
3.	7.9-8.4	250	62.50
4.	8.5-9.0	91	22.75
5.	>9.0	11	2.75

Table 2 : Saline conditions and categories of crop tolerance

Sr. No.	EC(dS/m)	Category	No.of soil samples	% of samples
1.	< 1.0	Normal	359	89.75
2.	1.0-2.0	Tending to become saline	32	8.00
3.	2.0-3.0	Saline	2	0.50
4.	> 3.0	Highly saline	7	1.75

value of 7.78 was recorded in a soil of Lakhpat taluka and the highest mean value of 8.58 was recorded in the soil of Mundra taluka. The relative high pH in the soils might be due to presence of high degree of base saturation. Similar results were also obtained for soils of Amritsar district of Punjab (Sharma *et al.*, 2008).

Electrical conductivity :

Conductivity, as a measure of current carrying capacity, gives a clear idea of the soluble salts present in the soil. It plays a major role in the salinity of soils. Lesser the EC value, low will be the salinity value of soil and vice versa. Overall, EC in the soils of Kachchh district varied widely ranged from 0.07 to 6.05 with a mean value of 0.57 dS/m. The lowest 0.07 dS/m EC value was recorded in the soil sample collected from Bhachau taluka, whereas highest value of 6.05 dS/m was recorded in Lakhpat taluka. The low EC of soil might be due to proper management of soil and thereby leaching of salt take place from surface to sub-subsurface soil. The results are strongly supported by the findings of Meena *et al.* (2006) in soils of Tonk district of Rajasthan. The soluble salts concentration above 4 dS/m in soil moisture inhibits the seed germination and growth of most commercial crops, which adversely affects the biomass production and economic yield.

Available macronutrients status and their influence in soil:

Organic carbon:

The soil organic carbon content surface soil ranged from 0.08 to 0.99 per cent with a mean value of 0.35 per

Table 3 : Chemical characteristics of the soils of Saharsa district

Soil characteristic	Mean	Range
Organic carbon (%)	0.35	0.08-0.99
Available N (kg ha^{-1})	193.93	62.72-392.00
Available P_2O_5 (kg ha^{-1})	41.85	16.81-116.58
Available K_2O (kg ha^{-1})	330.86	107.52-954.24

Table 4 : Correlation amongst the different soil parameters under study

	EC	pH	OC	Avail. N	Avail. P	Avail. K
EC	1					
pH	-0.028	1				
OC	0.017	0.193**	1			
Avail. N	0.045	0.178**	0.842**	1		
Avail. P	-0.011	-0.066	-0.040	-0.029	1	
Avail. K	0.029	0.052	-0.097*	-0.071	-0.035	1

* and ** indicate significane of values at P=0.05 and 0.01, respectively

Table 5: Nutrient index values and fertility status of nutrient in soils of Kachchh district

Name of taluka	Nutrient index values			Fertility status		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Bhachau	1.03	1.68	2.75	Very low	Marginal	Very high
Rapar	1.08	1.88	2.53	Very low	Marginal	High
Gandhidham	1.35	1.83	2.65	Low	Marginal	High
Anjar	1.28	2.03	2.48	Very low	Adequate	High
Mundra	1.20	1.93	2.38	Very low	Marginal	High
Mandvi	1.25	1.98	2.25	Very low	Marginal	Adequate
Bhuj	1.20	1.95	2.28	Very low	Marginal	Adequate
Nakhatrana	1.05	1.90	2.50	Very low	Marginal	High
Lakhpat	1.08	1.77	2.68	Very low	Marginal	Very high
Abadasa	1.05	1.45	2.90	Very low	Low	Very high
District	1.16	1.67	2.54	Very low	Marginal	High

cent. Such low values for organic carbon status of soils are expected because of the rapid decomposition and mineralization of organic matter in semi-arid and particularly negligible replacement of organic matter. Polara *et al.* (2006) also reported similar results for salt affected soils of North-West agro climatic zone of Gujarat. Available N (r = 0.178**) and O.C. (r = 0.193**) have highly significantly and positively correlation with pH. Similar result obtained for soils of Senapati district of Manipur (Athokpam *et al.,* 2013).

Nitrogen :

The nutrient index value for available nitrogen was ranged from 1.03 to 1.35 with mean value 1.16 which indicated that very low status of available nitrogen in soils of Kachchh district. Available N status for the targeted district was low, medium and it range from 62.72 to 392.00 kg/ha with a mean value of 193.93 kg/ha (Table 3). The highest mean value of available nitrogen was found in Gandhidham taluka (248.14 kg/ha) followed by Anjar (225.01 kg/ha) and Mundra taluka (220.31 kg/ha). The lowest mean value of available nitrogen was found in a soils of Bhachau taluka (151.70 kg/ha). Such lower values for available N might be due to lower content of organic carbon and poor addition of organic matter as well as less use of organic manures in the semi-arid area. The results are strongly supported by the findings of Polara and Kabariya (2006) in soil from Amreli district of Gujarat. The data of correlation values indicated highly significant positive relations between organic carbon with available nitrogen (r = 0.842**) (Table 4). Similar result obtained for soils of Tonk district of Rajasthan (Meena *et al.,* 2006).

Phosphorus:

The nutrient index value for available phosphorus ranged from 1.45 to 2.03 with mean value 1.67 which indicate available P_2O_5 was marginal in Kachchh district. The available P_2O_5 content of soil samples of Kachchh district varied widely from 16.81 to 116.58 kg/ha with mean value of 41.85 kg/ha (Table 3). The overall mean value of available phosphorus (41.85 kg/ha) indicated that the soils of Kachchh district was medium in available phosphorus status. The highest mean value of available P_2O_5 was found in Mandvi taluka (53.68 kg/ha) followed by Mundra (47.77 kg/ha) and Rapar (45.14 kg/ha) talukas. The lowest mean value was found in soil of Abadasa taluka (28.90 kg P_2O_5/ha). The medium status of available phosphorus in these soils might be due to regular application of phosphatic fertilizers to realize higher yields of oil seeds, which are the principal crops of the area. Similar results were obtained for soils of Tonk district of Rajasthan (Meena *et al.,* 2006). Available P_2O_5 showed negative correlation with pH (r = -0.066) and EC (r = -0.011) (Table 4). Similar result obtained for soils of Ausa tahsil of Latur district (Waghmare *et al.,* 2009).

Potassium :

The nutrient index value for available potassium was ranged from 2.25 to 2.90 with mean value 2.54 which indicate that available potassium content high in Kachchh soil (Table 5). Available potassium in soil varied widely from 107.52 to 954.24 kg K_2O/ha with an average value of 330.86 kg/ha (Table 3). The highest mean value for available K_2O was found in Abadasa taluka (517.44 kg/ha) followed by Lakhpat taluka (418.66 kg/ha) and Gandhidham taluka (343.88 kg/ha). The lowest mean value of available K_2O was found in Mandvi taluka (242.27 kg/ha). The high available potassium content in these soils might be attributed to the prevalence of potassium rich minerals like feldspars and muscovite and high potassic fertilizers use. Similar results were also obtained for salt affected soils in Amethi area of Uttar Pradesh (Chaudhary *et al*., 2006).

Conclusion:

The soil survey data of Kachchh district clearly indicate that the soils were moderately alkaline to very strongly alkaline in reaction with soluble salt content under slightly saline category. The soils of Kachchh district were low in organic carbon content and available nitrogen, medium in available phosphorus and high in available potassium status. On the basis of overall nutrient index, the soils of Kachchh district were very low in available nitrogen, marginal in available phosphorus and high in available potassium status.

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