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Study of presence of available nitrogen (N) through total organic carbon and fertility index of Kalol-Godhra taluka territory

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ABSTRACT:

This physico-chemical study of soil is based on various parameters like pH, conductivity, Total Organic Carbon, Available Nitrogen (N), Available Phosphorus (P_2O_5) and Available Potassium (K_2O). This study lead us to the conclusion of the nutrient's quantity of soil of Kalol and Godhra Taluka, District- Panchmahal, Gujarat. Results show that average all the villages of both these taluka have medium and high nitrogen content. The fertility index for total Nitrogen lies between 1.68 to 19.26. This information will help farmers to decide the problems related to soil nutrients amount of fertilizers to be added to soil to make the production economic.

Key words: Quality of soil, Total Organic Carbon, Available Nitrogen (N), Kalol, Gujarat

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INTRODUCTION:

Soil test based nutrient management has emerged as a key issue in efforts to increase agricultural productivity and production since optimal use of nutrients, based on soil analysis can improve crop productivity and minimize wastage of these nutrients, thus minimizing impact on environmental leading to bias through optimal production. Deficiencies of primary, secondary and micronutrients have been observed in intensive cultivated areas. Several States including Andhra Pradesh, Gujarat, Haryana, Karnataka and Uttar Pradesh have made commendable progress in soil testing programme in various ways such as expansion of soil testing facilities, popularization of the programme in campaign mode, development of soil fertility maps and use of information technology in delivering soil nutrient status and appropriate recommendation to farmers. This compendium is an effort to put together existing status of soil testing facilities state wise and highlight main issues in soil testing programme Compendium on soil health [1]. Soil is important to everyone either directly or indirectly. It is the natural bodies on which agricultural products grow and it has fragile ecosystem [2, 3].

The soil samples from 10 different villages of tribal area surrounding Dahod were collected. The physicochemical properties such as moisture content, specific gravity, pH measurement and estimations of Mg^{2+}, Na^{+}, K^{+} and Cl^{-}, HCO_3^{-}, PO_4^{3-}, NO_3^{-}% of soil were studied by Dabhi et al [4]. The fertility of the soil depends on the concentration of N, P, K, organic and inorganic materials and water. Nitrogen is required for growth of plant and is a constituent of chlorophyll, plant protein, and nucleic acids. Phosphorus is most often limiting nutrients remains present in plant cell nuclei and act as energy storage. It helps in transfer of energy. Potassium is found in its mineral form and affect plant cell division, carbohydrate formation, translocation of sugar, various enzyme actions and resistance to certain plant disease, over 60 enzymes are known to require potassium for activation. Amount of nutrients to be added to soil for crop production depend on their present amount in that soil. Fertilizer addition is recommended, now a day on STR (Soil Test Recommendation) basis in which contents of major nutrients (N, P, K) are determined following standard methods before sowing. Their values suggest quality of soil in terms of its nutrients contents i.e. high, medium or low nutrients. These nutrients content are than deduced from required amount of nutrients for following crop and this much amount of nutrients is now recommended for addition to soil [5]. One of The communication

deals with quality of soil of Dahegam Taluka. Soil samples were collected from forty different villages of Dahegam Taluka. Quality characteristics of soil such as pH, Electrical Conductivity (EC), Calcium (Ca^{2+}), Magnesium(Mg^{2+}), Bicarbonate (HCO_3^-), Chloride(Cl^-), Total Organic Carbon, Available Nitrogen (N), Available Phosphorus (P_2O_5) and Available Potassium (K_2O) were determined as per standard methods. Results show that 20% soils are deficient in organic carbon whereas 95% soils are deficient in available potassium [6].

Soil fertility testing is really the combination of three discrete but interrelated processes: analysis, interpretation, and recommendation [7]. Ştefanic's definition [8] approaches the most the fundamental biologic feature of soil fertility: Fertility is the fundamental feature of the soil, that results from the vital activity of micro-population, of plant roots, of accumulated enzymes and chemical processes, generators of biomass, humus, mineral salts and active biologic substances. The fertility level is related with the potential level of bioaccumulation and mineralization processes, these depending on the programme and conditions of the ecological subsystem evolution and on anthropic influences". This definition has the quality to be analytical. Understanding the definition in detail, the analyses of soil samples can be used for quantifying the level of soil fertility. According to H Pathak [9] The soil N fertility status in majority of the states was medium except in the North Eastern states, where the N status in soil was high. In West Bengal, the N fertility index increased from 1.47 in 1967 to 1.67 in 1997. Similar increasing trend was observed for Gujarat (1.13 in 1967 to 1.71 in 1997), Tamil Nadu (1.1 in 1967 to 1.34 in 1997). But the N fertility index declined in Orissa (1.92 to 1.57) and Kerala (from 2.11 to 1.66) during 1967 to 1997. In the remaining states the N fertility index remained almost same during the period. For the country as a whole the N fertility index increased from 1.59 to 1.79 during the last four decades (1967 to 1997).

Present study is an attempt to find out the nutrient's quantity in soil of Kalol and Godhra Taluka, District-Panchmahal, Gujarat. This information will help farmers to decide the amount of fertilizers to be added to soil to make the production economic. The objective of this paper was to analyze the trend in fertility status of soils of kalol and Godhra taluka of Gujarat State.

MATERIALS AND METHODS

The soil test data are the best source available to assess soil fertility status. Eighteen villages from kalol and one from Godhra taluka covering North, South, East and West, were selected for this study. A representative soil sample was collected from each village which represent soils of 4 to 10 farm's depending upon area of village. Representative soil samples were collected following standard quadric procedure and taken in polythene bags. In laboratory these samples were analyzed for different chemical parameters following standard methods [10]. AR grade reagents and double distilled water were used for soil analysis. Results were compared with standard values [11] to find out low, medium or high nutrient's content essential for STR.

Soil organic carbon is the seat of nitrogen in soil and its determination is often carried out as an index of nitrogen availability. In the colorimetric method [12,13] organic matter is oxidized with chromic acid (Potassium Dichromate + H_2SO_4). This method is widely used in Indian laboratories. The principle of this process is, The oxidizable organic matter in finely ground sample is oxidized by $Cr_2O_7^{-2}$ ions of $K_2Cr_2O_7$. The reaction is facilitated by spontaneous heat evolved by adding conc. H_2SO_4 in proportion to 2:1. The $Cr_2O_7^{-2}$ ions will reduce from Cr^{+6} to Cr^{+3} and give green color due to formation of chromus trivalent ions. Green color of Cr^{+3} is measured with spectrophotometer using 645 nm wavelength using red filter.The green color of reduced Cr^{+3} is used as a direct measured of quantity of carbon present is read from the graph prepared from the known quantity of organic carbon.

$$2K_2Cr_2O_7 + 8\ H_2SO_4 + 3C \quad \text{----------} \rightarrow 2K_2\ SO_4 + 2Cr_2(SO_4)_3 + 8\ H_2O + 3\ CO_2$$

The experimental procedure for determining organic carbon is as follows: Weigh 1.0 gm of soil sample into 250 ml glass beaker. Add 10 ml of 1 N $K_2Cr_2O_7$ solution and 20 ml of conc. H_2SO_4. Swirl a little and keep on asbestos sheet for 30 minutes. Add 20 ml Dist water and allow to stand for overnight. Read the green chromus color of the clear supernant on the spectrophotometer using 645 nm with red filter. Simultaneously run a blank without soil. Read the carbon from the standard curve. Express it as percent of the soil by the multiple factor. The total nitrogen value can be calculated from organic carbon by multiplying a standard factor. Based on the soil test values for different nutrients, soil samples are generally classified into three categories, low, medium and high (Table 1). Using these fertility classes nutrient index was calculated.

RESULTS AND DISCUSSION

Table 1 represents the range of Low, Medium and High nitrogen content as per standard of soil analysis, it is the permissible standard according to Anand Agricultural University.

Experimental values of quality characteristics especially total nitrogen of soil of the Kalol and Godhra Taluka with their fertility index are presented in the Table 2. This table represents the number of samples lies in Low, Medium and High nitrogen content. The same table represents the calculated values of fertility index for total nitrogen of the soil for all these 19 villages. Data presented in Table 2 shows that soils of few villages contain lower organic carbon and total nitrogen and some of the villages have high range of total nitrogen that might be due to the use of fertilizers or due to pulses (Beans) crops. Rest of the samples lies in medium range indicates good quality of soil suggest sufficient amount of presence of total nitrogen and hence no need of nutrient supplements to this soil. Results are in tune with farming practices followed by farmers of this region. Most of the farmer's are using chemical fertilizers, urea and nitrogenous fertilizers only, since last 25 to 30 years which contains concentrated amount of nitrogen and organic carbon and no phosphorus. Due to higher cost and rare availability of pottashtic or phosphatic fertilizers they are less preferred. On the basis of these results farmers are advised to use integrated nutrient management practice to maintain optimum concentration of all the essential nutrients for plants. Farmers are also advised to add biofertilizers containing organic carbon and nitrogen solubilising bacteria. The graphical representation clearly confirms the recent status of all 19 villages for the presence of total nitrogen in their soil. Figure 1 represents the village wise category for Number of samples lies in Low, Medium and High nitrogen content. This clears that how many samples were collected from the village and what is the status of nitrogen level in that sample whether it has Low, Medium or High nitrogen content. Using these fertility classes nutrient index was calculated as per the following equation.

Fertility index = (NL * 1 + NM * 2 + NH * 3) /100

Where, NL, NM and NH are number of samples falling in low, medium and high classes of nitrogen status of samples analyzed for a given area. Figure 2 shows the fertility index for total nitrogen is finally used for recommendation of fertilizers and crop selection.

Table 1: Range of Low, Medium and High Organic Carbon and Total Nitrogen content

Category	Organic Carbon in %	Total Nitrogen in %
Low	<0.50	<0.053
Medium	0.50 to 0.75	0.053 to 0.106
High	>0.75	>0.106

Table 2: Study of Presence of Nitrogen Content in the soil of Kalol and Godhra taluka territory

Element: Nitrogen, District : Panchmahal, TALUKA: 1 to 18 –Kalol, 19- Godhra

Sr No	Village Name	Number of samples	No of samples in LOW Nitrogen content	No of samples in MEDIUM Nitrogen content	No of samples in HIGH Nitrogen content	Fertility Index
1	Ghusar	375	99	203	73	7.24
2	Alindra	168	168	00	00	1.68
3	Kalantra	119	20	56	43	2.61
4	Royan	134	14	63	57	3.11
5	Barola	96	15	49	32	2.09
6	Fansi	87	9	66	12	1.77
7	Navagam	35	27	7	1	0.44
8	Zaradka	95	2	32	61	2.49
9	Paruna	313	1	36	276	9.01
10	Karada	254	1	174	79	5.86
11	Neshda	224	0	69	155	6.03
12	Jetpur	351	10	70	271	9.63
13	Katol	363	0	13	350	10.76
14	Chimnapur	163	0	0	163	4.89
15	Naranpura	176	0	49	127	4.79
16	Boru	282	0	144	138	7.02
17	Alva	912	0	810	102	19.26
18	Jeli	431	32	344	55	8.85
19	Ambali*	422	24	300	98	9.18
		5000				

Figure 1: Numbers of samples of all 19 villages of Kalol and Godhra taluka lies in Low, Medium and High Nitrogen content range

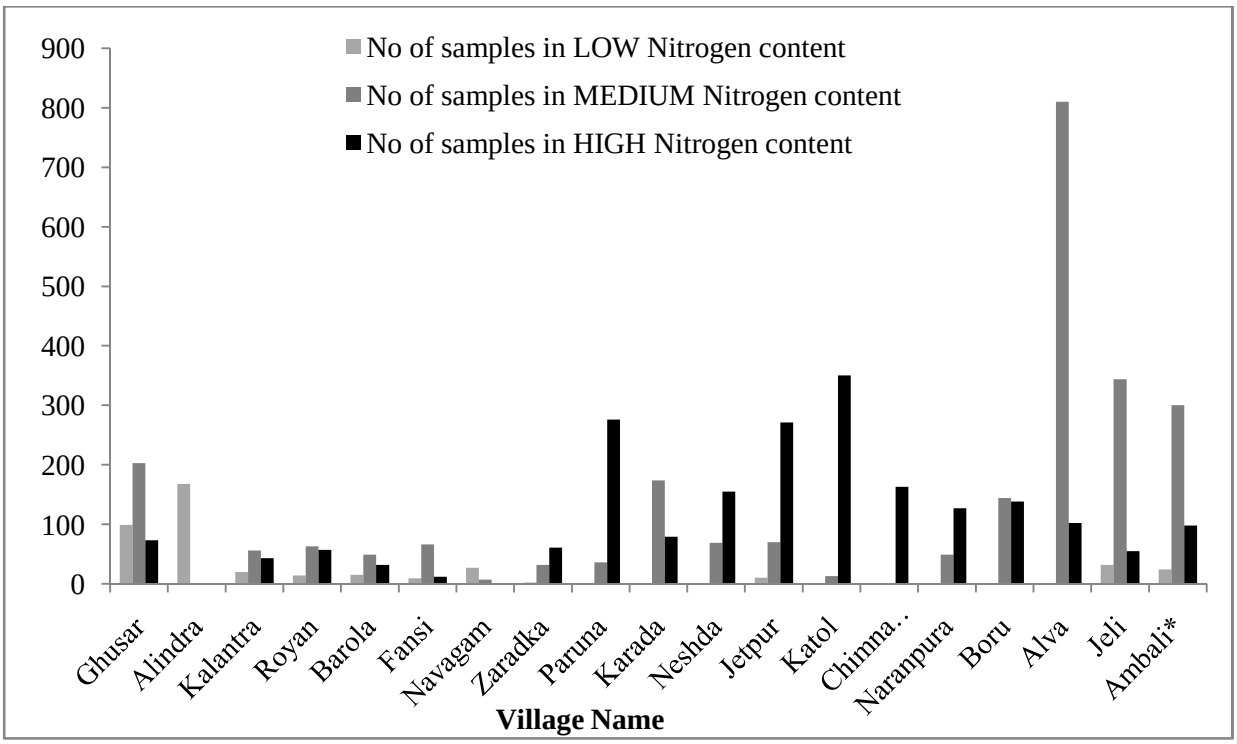
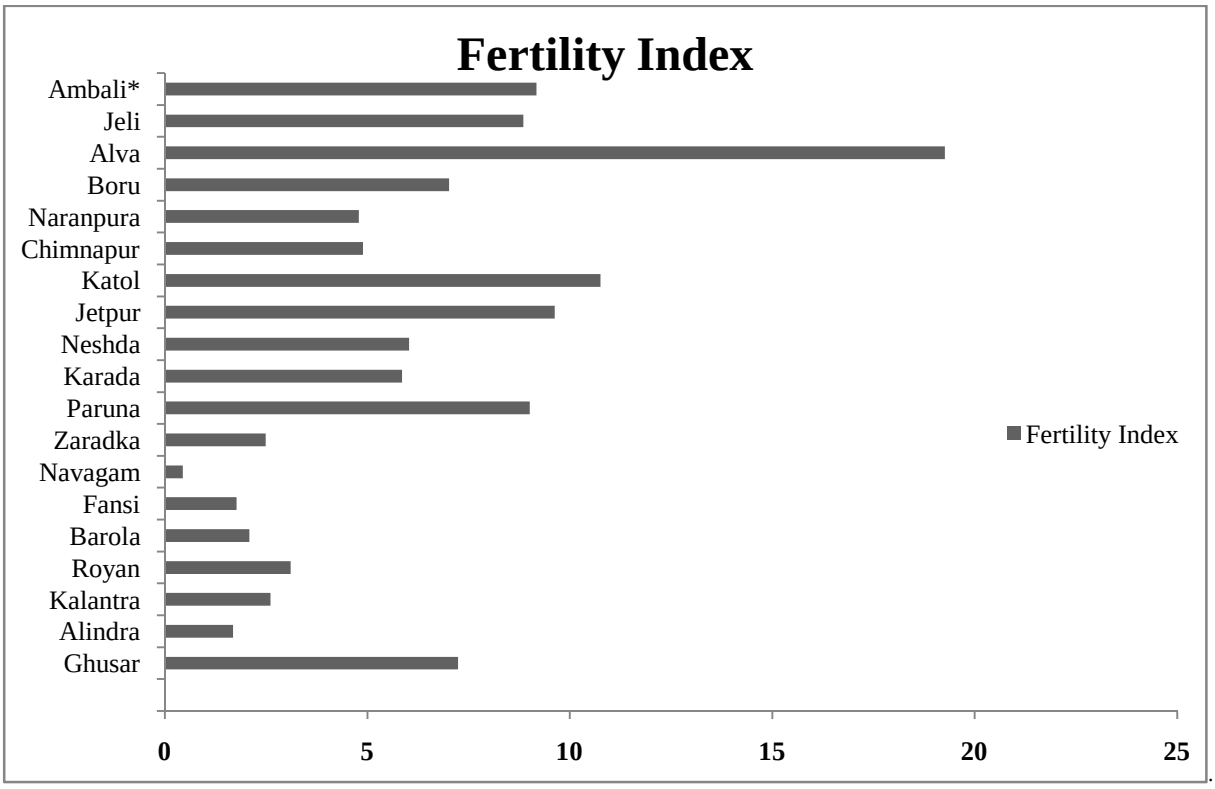


Figure 2: Fertility index for Nitrogen content of Kalol and Godhra Taluka territory of Panchmahal District



CONCLUSION

This can be concluded from this study that the organic carbon and total nitrogen deficient soil is recommended for nitrogen rich fertilizer. Thus this study evaluate soil fertility status for making fertilizer recommendations. To classify soil into different types of soil groups, fertility groups for preparing soil maps and soil fertility maps which are presented in form of graphics. To predict the probable crop response to applied nutrients. To identify the type

and degree of soil related problems like salinity, alkalinity and acidity etc. and to suggest appropriate reclamation/ amelioration measures. To find out suitability for growing crops and orchard. To find out suitability for irrigation. To study the soil genesis.

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