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Study of presence of available phosphorus in soil 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 Phosphorus content. The fertility index for phosphorus for both this taluka is 1.79. 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, fertility index, Kalol, Gujarat

INTRODUCTION

Soil is important to everyone either directly or indirectly. It is the natural bodies on which agricultural products grow and it has fragile ecosystem **[1, 2]**. 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 **[3].**

One of the group **[4]** studied soil samples of 10 different villages of tribal area surrounding Dahod. 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 well studied. 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].**

There is no intent with this system to make any interpretation as to the potential environmental impact of sensitive nutrients, such as phosphorus. This interpretation system is meant strictly for the determination of current soil suitability for agronomic or horticultural crop production. While nutrient availability can be important in gauging the potential for adverse environmental effects, it is only one factor in the overall picture. Slope, ground cover, incorporation of nutrient sources, timing of application, and other considerations all affect the potential movement of nutrients off-site and their potential for adverse environmental impact on surface and ground water **[7, 8]**. In cold climate, rapid root development early in the season is important. To encourage this, a small amount of starter fertilizer may be recommended for some crops even though the available level in the soil may be rated optimum or even excessive. This applies primarily to phosphate (P_20_5) recommendations, since an adequate available P level is critical in promoting early root growth. Starter fertilizer nutrient quantity is typically less than normal crop removal.
Soil fertility testing is really the combination of three discrete but interrelated processes: analysis, interpretation, and recommendation **[9]**. Ştefanic's definition **[10]** 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.

Phosphate (P_2O_5)Requirement for different crops is calculated by the equation**[11]**, P_20_5 requirement = crop removal + (50 - no. PX's) x multiplier = pounds per acre

The number of PX's is taken from the phosphorus bar graph, which is derived from the pounds per acre P test level. Phosphate requirements are also rounded to the nearest 10 pounds per acre. Minimum and maximum limits are also imposed, as with potash requirements. Crop removal values are different for each crop. The multiplier is derived from two factors: 1) The conversion from elemental phosphorus (P) to fertilizer phosphate (P_2O_5) - [roughly a factor of 2] and 2) The average efficiency or effectiveness of added phosphate for each crop. Efficiency is the percentage of fertilizer applied which is actually taken up or which remains plant available in the soil. Phosphate efficiency is a function of several factors including soil pH, soil organic matter level, whether the fertilizer is banded or broadcast, and how thoroughly the crop rooting system exploits the plow layer. See individual crop sections for assumed efficiency and crop removal factors.

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 **[12].**

The Olsen phosphorus test was originally developed for use on arid alkaline soils **[13,14].** The principle of this method is the heteropolycomplexs are thought to be formed by co-ordination of molybdate ions, with phosphorus as the cental coordinated atom, the oxygen of the molybdate radicals being substituted for that of PO_4^{-3}. This heteropolycomplexs give a faint yellow color due to their water solution, which on reduction with stannous chloride gives a blue colour. The intensity of the colour is read from a spectrophotometer at a wavelength of 660 nm using a red filter.

Soil colloid $H_2PO_4^-$ + HCO_3^- ---------→ Soil colloid HCO_3^- + $H_2PO_4^-$
$H_2PO_4^-$ + H_2MoO_4 ------------------→ $H_2P(Mo_3O_{10})_4$ + 12 H_2O
(Faint Yellow)
$H_2P(Mo_3O_{10})_4$ + $SnCl_2$ ----------------→ Phosphomolybdate
(Faint Yellow) Reduction (Blue)

The actual experimental Process for phosphorus measurement is: Weigh 5 gm of 2mm sieved soil into 250 ml plastic / glass bottle. Add one teaspoon of activated charcoal and 100 ml 0.5 M $NaHCO_3$ solution. Shake the bottle for 30 minutes on mechanical shaker. Filter the shaker through a Whatman No. 1 filter paper. Take 10 ml aliquot in a 50 ml volumetric flask. Add 10 ml ammonium molybdate solution, a little quantity of distilled water and shake well. Add 1 ml working $SnCl_2$ solution in each 50 ml volumetric flask. Make volume up to 50 ml with distilled water and shake well. Take reading on spectrophotometer within 10-15 minutes after blue color has been developed, as this color is not stable for more than 15 minutes. Use 660 nm wavelength and red filter. Run a blank with all the reagents, except the soil. Determine P concentration in the given soil sample using standard curve.

AR grade reagents and double distilled water were used for soil analysis. Results were compared with standard values **[15]** to find out low, medium or high nutrient's content essential for STR. The available phosphorus value can be calculated 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/ fertility index was calculated.

RESULTS AND DISCUSSION

Table 1 represents the range of Low, Medium and High Phosphorus content as per standard of soil analysis, it is the permissible standard according to Anand Agricultural University. This values are used to determine the category of soil whether the soil sample have Low Medium or High content of Phosphorus.

Experimental values of quality characteristics especially for available Phosphorus 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 Phosphorus content. The same table represents the calculated values of fertility index for available Phosphorus of the soil for all these 19 villages. Data presented in Table 2 shows that soils of few villages contain lower available Phosphorus and very few villages have high range of available Phosphorus that might be due to poor or excessive use of fertilizers. Wide range of infect average all the samples lies in medium range indicates good quality of soil suggest sufficient amount of presence of available Phosphorus 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 compost and chemical fertilizers, urea and phosphatic fertilizers only, since last 25 to 30 years which contains concentrated amount of nitrogen and organic carbon, potassium and phosphorus. 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 available Phosphorus in their soil. Table 3 represents the taluka wise status of Low, Medium and High category of samples having Phosphorus.

Figure 1 represents the village wise category for Number of samples lies in Low, Medium and High Phosphorus. This clears that how many samples were collected from the village and what is the status of Phosphorus level in that sample whether it has Low, Medium or High nitrogen content. Using these fertility classes nutrient/ fertility 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 Phosphorus status of samples analyzed for a given area. Figure 2 shows the fertility index for available Phosphorus is finally used for recommendation of fertilizers and crop selection.

Table 1: Range of Low, Medium and High category of Available Phosphorus in the form of P_2O_5

Category	Total Available phosphorus
Low	<28 kg P_2O_5/ Ha
Medium	28-56 kg P_2O_5/ Ha
High	>56 kg P_2O_5/ Ha

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

District : Panchmahal *TALUKA: 1 to 18 –Kalol & 19- Godhra*

Sr No	Village Name	Number of samples	No of samples in LOW Phosphorus content	No of samples in MEDIUM Phosphorus content	No of samples in HIGH Phosphorus content	Fertility Index
1	Ghusar	375	235	140	0	5.15
2	Alindra	168	108	60	0	2.28
3	Kalantra	119	40	79	0	1.98
4	Royan	134	41	92	1	2.28
5	Barola	96	11	84	1	1.82
6	Fansi	87	15	72	0	1.59
7	Navagam	35	4	31	0	0.66
8	Zaradka	95	7	87	1	1.84
9	Paruna	313	24	285	4	6.06
10	Karada	254	0	254	0	5.08
11	Neshda	224	6	217	1	4.43
12	Jetpur	351	0	348	3	7.05
13	Katol	363	0	355	8	7.34
14	Chimnapur	163	0	163	0	3.26
15	Naranpura	176	0	175	1	3.53
16	Boru	282	0	272	10	5.74
17	Alva	912	0	896	16	18.4
18	Jeli	431	0	431	0	8.62
19	Ambali*	422	0	422	0	8.44
		5000				

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

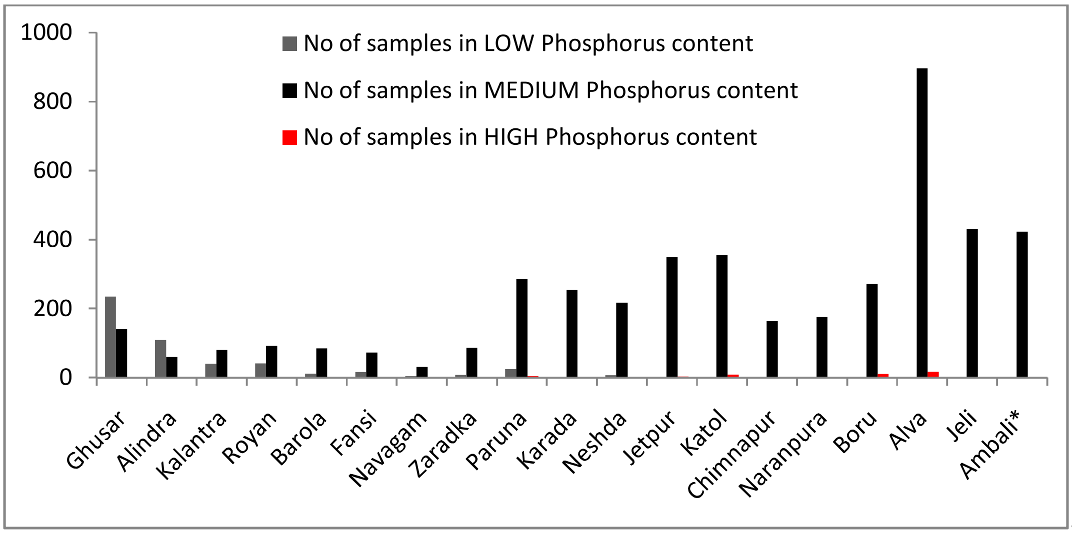

Figure 2: Fertility index for Nitrogen content of Kalol and Godhra Taluka territory of Panchmahal District

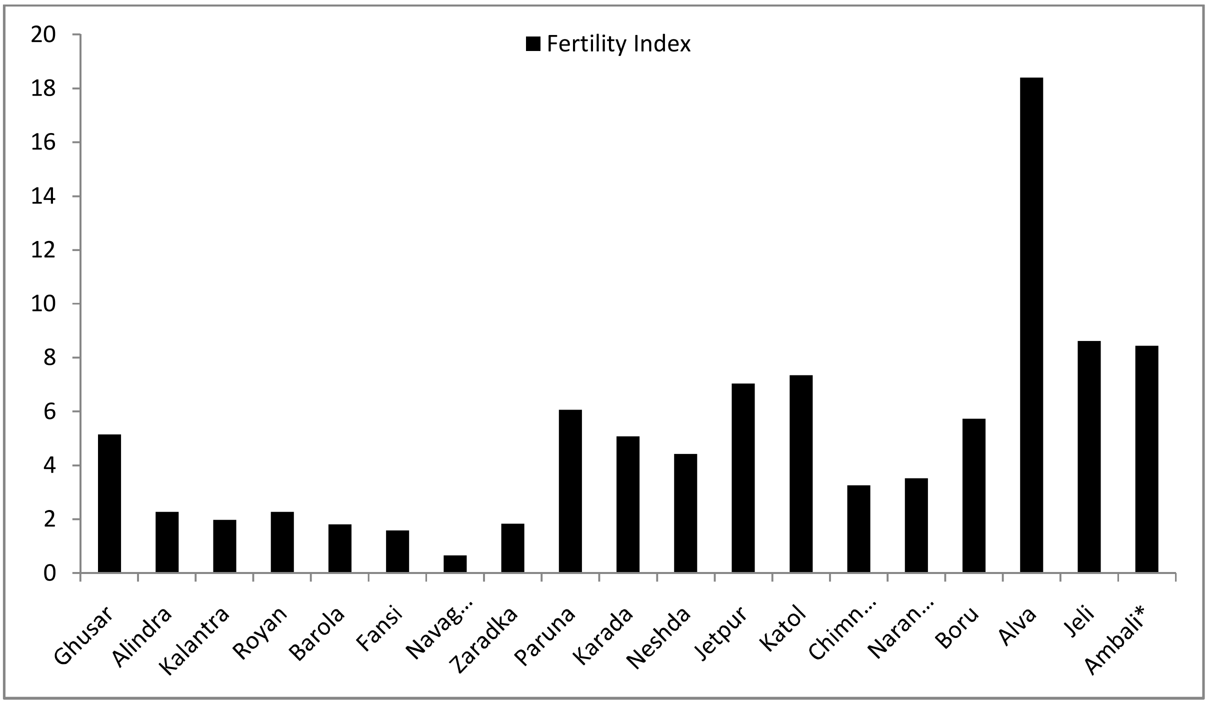

Table 3: Status of available phosphorus in form of P_2O_5 in the soil of Panchmahal District

Sr. No	Taluka	Element	Category of phosphorus			Total No of Samples	Fertility Index
			Low	Medium	High		
1	Kalol	phosphorus	491	4041	46	4578	1.79
2	Godhra	phosphorus	0	422	0	422	1.79
3	Panchmahal District	phosphorus	491	4463	46	5000	1.91

CONCLUSION

This can be concluded from this study that the available Phosphorus deficient soil is recommended for Phosphorus rich fertilizer. Average all villages have medium category of available Phosphorus so no need to add Phosphorus contained fertilizers. 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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