Physico-Chemical Status of Agricultural Soil in Selected Villages in Shrirampur Tehsil of Ahmednagar District (Maharashtra State)

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Abstract

The present study was carried out to measure the Physico-chemical analysis of soil samples in selected villages of Shriramur tehsil of Ahmednagar district. A simple random sampling technique was employed for the selection of soil samples. Herein we have collected a total of 20 soil samples between 2017 and 2018 from 4 different village's viz. Govardhanpur, Gujarwadi, Kadit Budruk and Kadit Khurd of Shrirampur Tehsil. The physical properties of a generally black and deep black type of soil are having a moderate level of textural profile and water holding capacity taken into account. Analysis of chemical parameters clearly shows that soil pH ranges from 7.33 to 9.13 and electrical conductance ranges from 0.10 to 0.52 dS/m-1 indicate non-saline and alkaline types of soil. Moderate to the high proportion of NPK and good organic carbon present in most of the soil samples indicate highly fertile soil whereas, Sulphur and Boron Nutrients deficiency was observed in sample villages. Therefore, there is a need for proper utilization of manures and chemical fertilizers in agricultural practices.

Key words: *Physico-Chemical, Soil Fertility, Soil Status, Organic Carbon.*

Introduction

In any agricultural operation, the soil is of the utmost importance as it is the cradle for all crops and plants. The topsoil having an average depth of about 15 to 20 cm on the face of the land is the natural body of soil on which plants grow and the farming activities flourish. The standard of living of people depending on agriculture is often determined by the fertility and productivity of soils (Majid Husain, 1996). Soil macronutrients, namely, nitrogen, phosphorus, and potassium are critical elements for crop growth and yield (Pritty S Babu, 2020). In recent years, the adoption of high yielding varieties and the use of N, P, K fertilizers led to a decline in the status of sulphur and micronutrients in the soil to below normal at which productivity of crops cannot be sustained. Inventory of available S and micro-nutrients status of the soil helps in demarcating areas where application P particular nutrients are needed for profitable crop production (Ranvir Singh and Sarika Yadav, 2017).

Healthy soil is a key component of sustainability. Soil fertility decline is considered as an important cause for low productivity of many soils (Sanchez P.A., 1976), it has not received the same amount of research attention as soil erosion, probably because as soil fertility decline is less visible, less spectacular, and more difficult to assess. Assessing soil fertility decline is difficult because most soil chemical properties either change very slowly or have large seasonal fluctuations. This decline includes nutrient depletion, acidification (decline in pH), loss of organic matter and an increase in toxic elements e.g., Al, Mn (Hartemink, A.E., 2006).

As crop production involves a complex interaction between the environments, soil parameters, industrialization, overdoses of chemical fertilizers, over-irrigation, similar crop patterns and other anthropogenic activities the soils get polluted. In this context, the soil must be studied in terms of productive potentials. Failure to understand these complexities has resulted in a lack of good crop production and management techniques; hence agricultural production has tended to be low (G. S. Wagh and S.U. Deshmukh, 2014). The present study mainly deals with the measurement of various physic-chemical parameters of soil samples collected from villages in Shri Rampur tehsil. Soil mostly classified into their black and deep black in color, soil pH, Electrical Conductance, the proportion of Nitrogen, Phosphorous, Potassium, Sulphur, Boron and Organic Carbon.

Material and methods

As many as 5 farm soil samples from each village were selected for Physico-chemical evaluation of soil. A total of 4 villages were randomly selected for study purposes. The soils were sampled at soil depths of 0- 15cm to make a detailed characterization of selected soils. Efforts have also been made to examine the impact of each parameter on soil quality and crop yield.

For the present investigation, all reagents and chemicals were used for an analytical grade as well as without any purification. Distilled water was used for the preparation of soil suspensions and the evaluation of various soil properties throughout the investigation. Nitrogen computed by using the Kjeldhals method, Phosphorous and Boron analyzed spectrophotometrically, Sulphur and Organic Carbon measured by the volumetrically.

Study Area

Shrirampur is located in the Northern part of the Ahmednagar district of Maharashtra. It is extended in between 19° 45' to 20° 30' North latitudes and 74° 00' to 74° 30' East longitudes (K. C. Ramotra et al. 2016). As per the 2011 Census, the total geographical area of tehsil is 542.60 sq. km which covers 56 villages. The net sown area is 84.98 % which is larger than the district average of 68.11 % and also larger than the state average of 56.59 %. The total population of tehsil is 287500 out of which 146510 are male and 140990 females and occupies 6.33 % population of the district. There are 61.9 % of workers engaged in the Agricultural sector, (52.5 % male and 83.53 % male) whereas 38.1 % of workers engaged in the Non-agricultural sector.

The distribution of rainfall is very uneven in the study region during 2017-18. The average annual rainfall in the district is 578.8 mm. the western part of

Akole tahsil gets good rainfall, further, it gradually decreases towards the east, but from the line roughly north-south in the central parts of the district the rainfall again gradually increases towards the eastern part of the district. September is the rainiest month and about 77 % of the annual rainfall in the district is received during the south-west monsoon season in the district. There are 4 villages viz. Govardhanpur, Gunjarwadi, Kadit Budruk, and Kadit Khurd are randomly selected and by using standard techniques of analysis physic-chemical properties of soil samples are evaluated. Lastly, obtained data is represented in the form of tables and parameters correlated with the help of graphs.

Analysis of Soil Samples

The soil samples were collected from March to May during 2017 and 2018 in clean polythene bags of 500 gm capacity. These Soil samples were collected from the selected agricultural field area with usual precautions. All soils were collected and sampled reduced by coning and quartering technique and air-dried overnight at room temperature. The soil was sieved through a 5 mm mesh to remove plant residues and representative subsamples were ground and passed through a 20 mm mesh. The soil bottles were tightly sealed and labeled and kept at a constant temperature. Soil Samples were soaked overnight for the measurement of its Organic Carbon content.

The soil physical parameters analyzed were soil texture, where sieving of soil was done on various diameters sieves, soil colour by visual observation, soil moisture content by oven drying at 120°C for 24 hrs in an electric oven and water holding capacities (WHC) by standard methods. The soil chemical quality parameters also analyzed, where pH measured by using Digital pH meter (ELICO: LI-120), Salt load (electrical conductivity) by Digital Conductivity meter. Nitrogen was measured by using the Kjeldhals method, while Boron and Phosphorous measured by using Spectrophotometric method, Sulphur by Volumetric method, and Potassium by Flame emission spectroscopy. Table I Indicates the location of soil sample with sample ID whereas, in a detailed analysis of the Physico-chemical properties of the soil samples of selected villages in Shrirampur tehsil were represented in Table II.

Table 1: Location of Soil Sample with Sample ID

Sr. No.	Village/ Location	Sample ID	Sr. No.	Village/	Sample ID
1	**Govardhanpur**	G_1	11	**Kadit Budruk**	K_{B1}
2		G_2	12		K_{B2}
3		G_3	13		K_{B3}
4		G_4	14		K_{B4}
5		G_5	15		K_{B5}
6	**Gujarwadi**	Gw_1	16	**Kadit Khurd**	K_{K1}
7		Gw_2	17		K_{K2}
8		Gw_3	18		K_{K3}
9		Gw_4	19		K_{K4}
10		Gw_5	20		K_{K5}

Results and discussion

The soil physical properties namely Porosity, Maximum water holding capacity, Texture and structure affects mostly due to the rainfall pattern. It is noticed from (Table II) that, the color of most of the soil samples is black in color and deep black in few cases ie. Gw_2, Gw_5, and K_{B5} soil samples. The textural pattern of soil sample under study was 65% fine, 30% clay and 5% loamy. It is also found that the maximum water holding capacities for all the soils under investigation lies in between 49 % to 78 %.

Soil pH generally refers to the degree of soil acidity or alkalinity. Soil pH affects the physical, chemical, and biological properties and processes, as well as plant growth. Soil microarthropods perform an important role in the growth of plants. Soil microarthropods increase soil porosity and soil fertility (D. Pahari and P.K. Samanta, 2020). Soil chemical parameters such as pH and EC are presented in Table 2 (Fig.1) shows that soil pH ranges from 7.33 to 9.13. Soils G_2,G_3,G_4,Gw_1,Gw_2,Gw_3,Gw_4,Gw_5,K_{B5},K_{K1},K_{K2} identified pH values with more than 8 pH which highlight their alkaline nature. Further, electrical conductance is ranging from 0.10 to 0.52 dS/m-1 indicate non-saline and alkaline type of soil. The effect of soil pH is profound on the solubility of minerals and nutrients. Particularly, profound yields useful information about the availabilities of exchangeable cations (e.g. Ca^{2+}, K^{+}, etc) in soils. Most minerals and nutrients are more soluble or available in acidic soils than in neutral or slightly alkaline soils (D. N. Sonawane et al., 2014).

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Table 2: Physico-chemical properties of the Soil Samples of Selected Villages in Shrirampur Tehsil

Soil Sample	Colour	pH	E.C. X 10^{-3}	Nitrogen (N)	Phosphorous (P)	Potassium (K)	Sulphur (S)	Boron (B)	Organic Carbon (C)
G_1	Black	7.51	0.11	673.10	21.94	251.30	3.36	0.38	0.45
G_2	Black	8.24	0.43	317.50	36.57	104.83	2.40	0.19	1.22
G_3	Black	8.26	0.47	317.50	36.50	104.50	2.40	0.17	1.27
G_4	Black	8.01	0.32	139.70	34.37	99.45	6.93	0.22	0.91
G_5	Black	7.33	0.13	285.80	16.09	249.98	2.97	0.63	0.74
Gw_1	Black	8.45	0.50	283.30	12.73	66.78	4.40	0.51	0.24
Gw_2	Deep Black	8.45	0.15	392.10	16.10	76.66	20.20	0.49	0.19
Gw_3	Black	8.51	0.52	128.90	18.90	94.48	13.60	0.43	0.98
Gw_4	Black	8.64	0.48	546.00	45.16	93.24	12.40	0.47	0.99
Gw_5	Deep Black	8.55	0.14	315.00	46.10	40.98	10.40	0.34	0.13
K_{B1}	Black	7.49	0.23	628.60	52.69	107.52	9.60	0.27	0.46
K_{B2}	Black	7.75	0.25	121.50	12.50	154.20	5.20	0.15	0.37
K_{B3}	Black	7.60	0.32	375.80	28.52	189.50	4.81	1.25	1.27
K_{B4}	Black	7.36	0.28	389.70	21.94	129.60	14.30	0.56	0.77
K_{B5}	Deep Black	9.13	0	154.55	8.89	107.52	6.40	0.15	0.11
K_{K1}	Black	8.86	0.15	110.90	22.70	122.80	39.20	0.31	0.75
K_{K2}	Black	8.14	0.10	261.16	24.86	212.20	14.13	0.77	0.58
K_{K3}	Black	7.67	0.12	612.60	26.80	220.28	17.60	0.21	0.60
K_{K4}	Black	7.70	0.24	660.00	19.74	189.50	5.00	0.41	0.71
K_{K5}	Black	7.70	0.21	514.30	19.77	169.30	44.40	0.61	0.71

Note: EC in dS/m-1, Nitrogen, Phosphorous, Potassium in Kg/ha and other chemical parameters are in mg/kg.

Soil macronutrients namely, nitrogen (N), phosphorus (P), and potassium (K), are vital elements for crop growth and yield (Table 2 & Fig. 2). Their reliable assessment in a rapid manner at varying space and time domains is an essential pre-requisite of site-specific soil and crop management programs or precision agriculture (Kim *et al.*, 2009). The N, P, K nutrients are required by crops in the largest amount, therefore they are considering as the most significant nutrients hence, the availability of N, P, K in the soil should be sufficient, but not too high. Moreover, the N, P, K availability should be balanced. A higher proportion of one or more nutrients may adversely be affected by the growth of the plant and the yield of the crop. The N, P, K nutrients content varies from sample to sample. The measurement N, P, K properties show their moderate to high proportion. Proportions of Nitrogen vary from 110.90 to 673.10 kg/ha proportion of Phosphorous content varies from 8.89 to 52.69 kg/ha, and Potassium content ranges from a minimum of 40.98 kg/ha to maximum of 251.30 kg/ha. Moderate to a high level of Nitrogen and Phosphorous observed in the selected sample, but at the same time, 11 soil samples identified with low to very low (Gw_4, Gw_4) level of Potassium.

Sulphur deficiency in crop plants has been recognized as a limiting factor not only for crop production but also for the poor quality of products (Ranjeet Singh et al. 2020)**.** The Proportion of Sulphur, Boron and Organic Carbon present

in soil samples represented in Table 2 & fig.3 show that the values of Sulphur range minimum from2.40 to a maximum of 44.40 mg/kg whereas, values of Boron ranges minimum from 0.15 to maximum of 1.25 mg/kg. Mostly soil samples (50 %) show a very low level of Sulpher and very low level of Boron. Limited use of sulphur and boron-containing fertilizer, intensive agriculture with a mono-cropping pattern of sugarcane is responsible for the sulphur and boron deficiency.

A good proportion of Organic Carbon was present in most of the soil samples. Relatively stable EC levels in the organic system indicate that animal manures did not increase salinity (M. Sean Clark et al. (1998). Vermicomposting is a low-technology, environmentally-friendly process used to treat organic waste. The resulting vermicompost has been shown to have several positive impacts on plant growth and health (Cristina Lazcanoa and Jorge Dominguezb (2011). The proportion of Organic Carbon is ranging in between 0.11 to 1.27 mg/kg. It indicates that high fertile soil containing high organic matter whereas; Sulphur and Boron nutrients deficiency was mostly observed in sample villages. Hence, there is a need of proper utilization of manures, chemical fertilizers in agricultural practices.

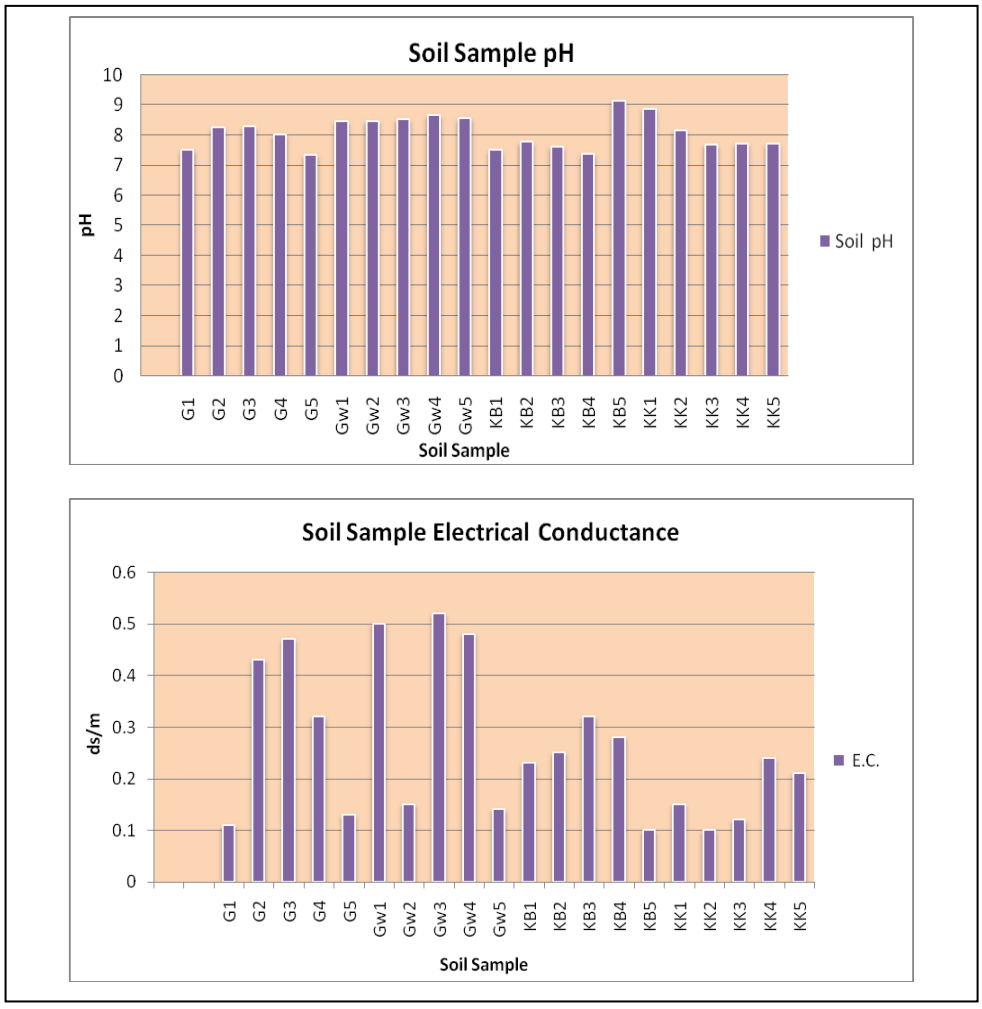

Figure: 1 Proportion of pH and Electrical Conductance in Soil Samples

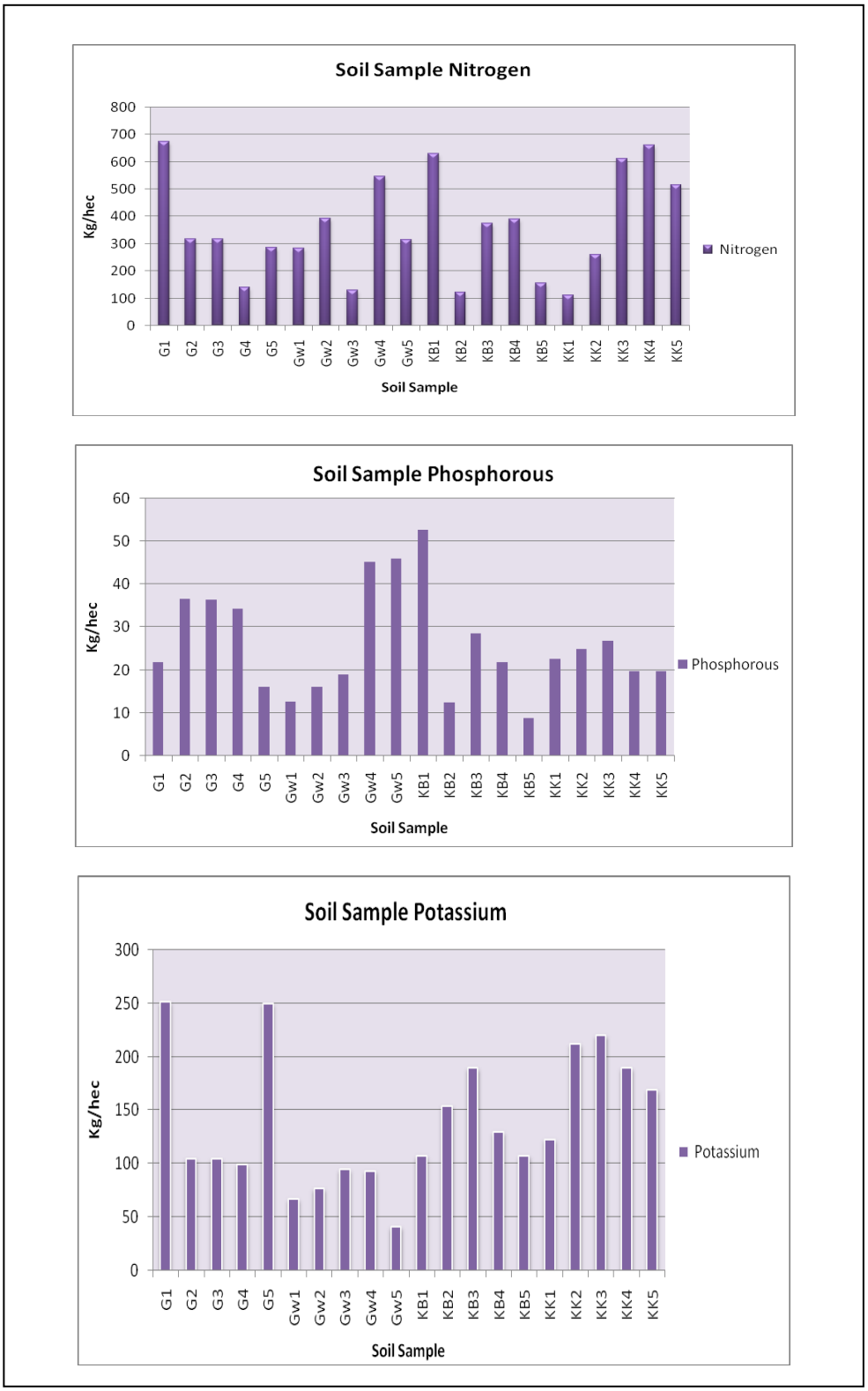

Figure: 2 Proportion of Nitrogen, Phosphorous, and Potassium in the soil samples

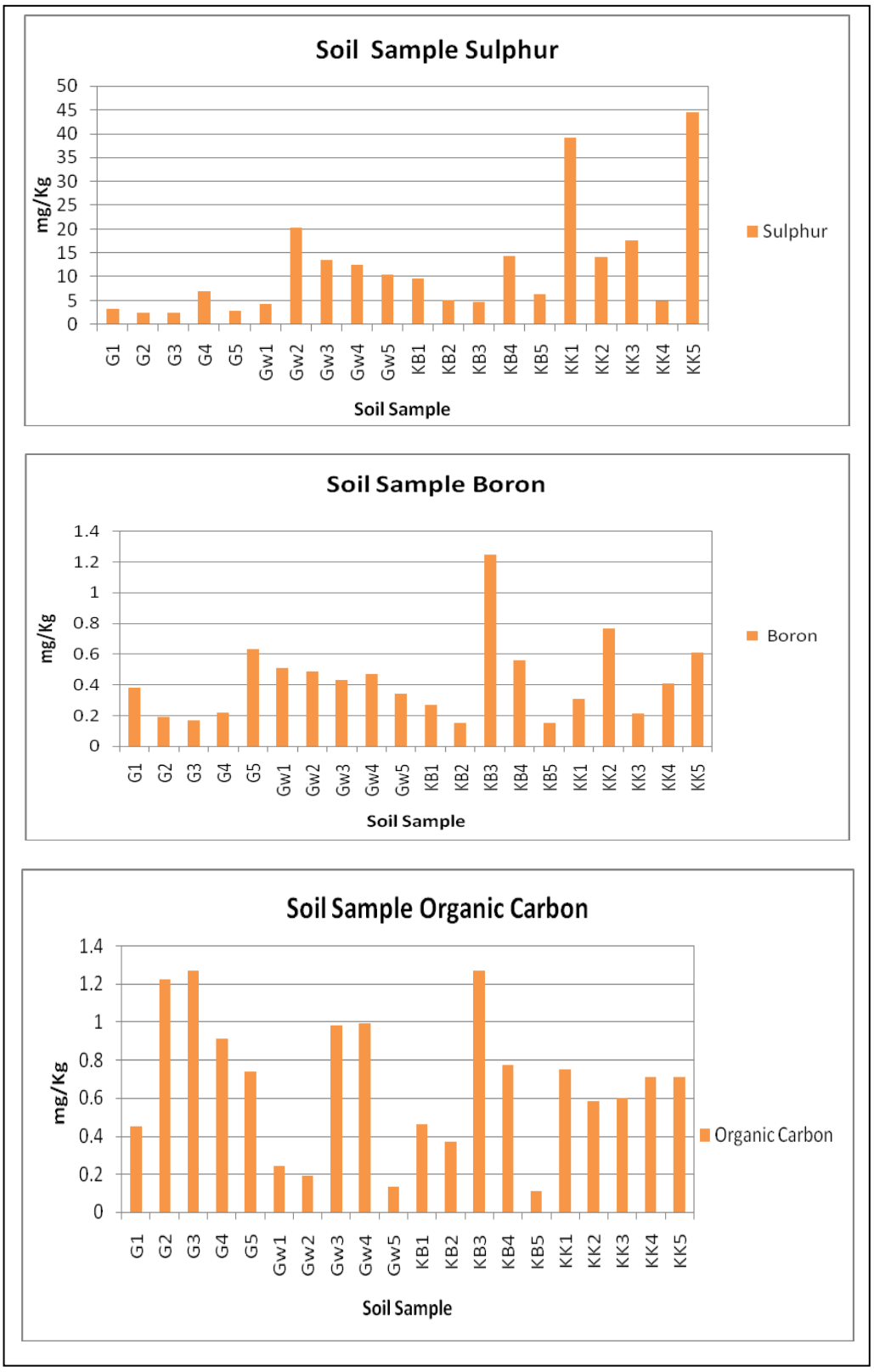

Figure: 3 Proportion of Sulphur, Boron and Organic Carbon in soil samples

Conclusions

Present Physico-chemical investigation of soil samples shows physical properties generally black and deep black type of soil is having a moderate level of textural profile and water holding capacity. Analysis of chemical parameters clearly shows that soil pH ranges from 7.33 to 9.13 and electrical conductance is ranging from 0.10 to 0.52 dS/m-1 indicates the non-saline and alkaline type of soil. Moderate to the high proportion of N, P, K and good Organic Carbon present in the most of the soil samples indicate highly fertile soil whereas, Sulphur and Boron nutrients deficiency was observed in sample villages. Therefore, there is a need of proper utilization of manures and chemical fertilizers in agricultural practices. Farmers should flourish vermicompost on a large scale and utilized it on their farm. The present study reveals that agricultural soil containing a high proportion of organic matter and accordingly better is the status of agricultural soil in the study area.

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