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Assessment of Soil Properties in Different Villages of Faridabad, India

Priya Choudhary[1], Ambrina S. Khan[1], Shakeel A. Khan[2*] and Richa D. Nagar[1]

[1]Amity Institute of Environmental Sciences, Amity University, Noida, Uttar Pradesh, India
[2]Indian Council of Agricultural Research-Indian Agricultural Research Institute, New Delhi, India

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ABSTRACT

The present study aimed to assess the physicochemical properties of soil in Faridabad since this region is a hub of industries and agriculture is also practiced. This study was done to analyze any possible impacts of pollution in soil. Ten sites in Faridabad were selected to determine the soil physicochemical properties. Rice and wheat crops are grown in these agricultural lands from where the soil samples were collected. pH, EC, N, P, K, Fe, Mn, Al, B, water holding capacity and cation exchange capacity were measured in soil samples at two depths (0-15 cm and 15-30 cm). The soil samples did not show any harmful values. The values were within the acceptable range and do not have any sign of pollution in soil. The pH was neutral to moderately alkaline, EC values was <1ms/cm and NPK was mostly in moderate range. Fe, Mn, B and Al were in the acceptable limit and did not have any toxic effects.

Key words : *Soil, Nutrients, Available, Concentration, Agriculture*

Introduction

India, being an agronomical country, its majority of the economy comprises of agriculture sector. In Haryana, 70% of the population is engaged in agriculture practice despite recent industrial development in this region. Faridabad is one of the largest and populous cities in Haryana and is also a part of National Capital Region (NCR). There are different crops grown in Faridabad district such as gram, pulses, jowar, bajra, rice and wheat. One of the most important environmental components in terms of agricultureis soil which makes food for animals and human beings. Soil play a major role for growing the agricultural crops. The porosity of soil supports the plant root during its growth by holding water, heat, nutrients and air and also gives mechanical strength to the plant. It is considered as reservoir of nutrients however the nutrient levels may not be at optimum level for direct availability to plants. The aim of analysis of soil is to evaluate the sufficiency, excess or scarcity of available nutrients for the growth of crops and to observe the alteration caused by farming practices. The availability of macro and micronutrients determines the soil fertility which is responsible for the plant growth. The stability, sustainability and productivity of soil are limited by the deficiency of nutrients. The availability of micronutrients in the soil depends on weathering process and the mineral type found in soil. However, excessive and unbalanced application of chemical fertilizers has caused shortage of multiple nutrients which decreases the fertility of soil and yield of crops (Ingle *et al*., 2018). Intensive agriculture reduces the nutrient reservoir of soil and the crops began responding to chemical fertilizers. Anthropogenic activities have a negative impact on the environment, which might be either direct or indirect on agricultural land. It is

necessary that we adopt organic farming over chemical fertilizer farming (Usman *et al.,* 2016). Application of suitable rates of N, P, and K fertilisers can boost soil Cu, Zn, and Mn availability, as well as Cu, Zn, Fe, and Mn concentrations in wheat (Li *et al*., 2007). The depletion of essential micronutrients in both unfertilized and NPK treated plots suggested that these nutrients were taken from the soil to meet crop requirements, and hence their supplementation is necessary (Mohrana *et al.,* 2016). Also, growing the same crop continuously for years also decreases the fertility of soil (Singh *et al.,* 2007). Rice and wheat are the staple crops of India and are majorly grown in the selected villages of our study area. Therefore, it is necessary to analyse the quality of soil in regular time period for the high production and yield of staple crops. In the present study, the soil samples were taken in the interval of three months for the consecutive three years to assess the change in physicochemical properties of soil in ten different sites of Faridabad.

Methodology

Study Area

The study area was Faridabad, Haryana, India.The district of Faridabad is divided into two subdivision- Faridabad and Ballabgarh. The district is mostly drained by the perennial Yamuna River. The climate in the Faridabad district can be classified as tropical steppe, semiarid, and hot, with the air being extremely dry, except during the monsoon season. The sites are selected on the basis of crops grown where rice and what are majorly cultivated. Ten villages in Faridabad were selected for the sampling of soil. Mujedi, Tigaon, Faridpur, Sadupur, Mandhawali, Bhuapur, Gharora, Ghazipur, Badraula and Khera are the study sites. The soil samples were taken from two depths 0-15cm and 15-30cm.

Soil sampling

The soil samples were collected from ten villages for consecutive three years. The samples were taken in the interval of three months from June 2016 to March 2018. The samples were taken from two depths (0-15 cm and 15-30 cm) with the help of auger. Soil samples were air dried followed by grinding and sieving to 2 mm for further analysis. Physicochemical parameters such as pH, Electrical conductivity (EC), available nitrogen, available phosphorous, available potassium, Fe, Mn, Al, Boron, water holding capacity and cation exchange capacity of soil samples were analyzed in laboratory.

pH

pH of the soil was analyzed by making a mixture of soil and water in 1:2 ratio. 20 g of soil was mixed with 40 ml of water in 100 ml beaker. It was stirred in regular interval for 30 minutes and pH was measured using pH meter.

Electric conductivity (EC)

EC was measured by EC meter. The mixture prepared for measuring pH was kept for 24 hours. After 24 hours the soil settles in the bottom of the beaker. Then, gently and carefully the EC was measured.

Available Nitrogen

Alkaline potassium permanganate method was used for the analysis of available nitrogen (Subbiah *et al.,* 1956). 5 g of soil was taken in distillation tubes and distillated with potassium permanganate and sodium hydroxide. In conical flask, boric acid mixed indicator was added for the absorbtion of ammonia. After the absorption, the pink color turns green. 150 ml distillate is collected and titrated with 0.02N of sulphuric acid which turns the green color to pink color. Blank is also run in similar way but without soil sample.

Available Phosphorus

Available phosphorous of soil was extracted using $NaHCO_3$. The extracting solution was filtered with Whatman filter paper. In 5 ml of aliquot, H_2SO_4, water and ascorbic acid was added. The concentration of Phosphorus was measured using spectrophotometer at 660nm. Standard curve was prepared using different concentration of Phosphorus solution i.e., 1, 2, 3, 4 and 5ppm. Same steps were followed by adding $NaHCO_3$ (Olsen 1954).

Available potassium

Available potassium of soil was extracted with ammonium acetate. The solution was shaked and filtered through Whatman filter paper. Flame photometer was used for measuring the phosphorous concentration. Standard curve was prepared using KCl and same procedure was repeated for obtaining the

curve (Hanway and Heidel, 1952).

Iron and Manganese

Atomic absorption spectrophotometer (AAS) was used for the analysis of Fe and Mn in the soil. In 12.5 gm of soil DTPA (Diethylenetriaminepenta acetic acid) was added. The solution was shaked for 2 hours and filtered through Whatman filter paper. The concentration of Fe and Mn was measured by AAS (Lindsay *et al.,* 1978).

Boron

Boron was analysed by the method of hot water soluble extraction (Berger *et al.,* 1939). In 20 g soil, $CaCl_2$ was added in conical flask. The flask was attached to water cooled reflux condenser. It was heated and then filtered. 20 ml of the aliquot was transferred to the evaporating dish and $Ca(OH)_2$ was also added. It was heated till dryness to destroy the organic matter. HCl was added in the residue. Then, take the spectrophotometer reading at 420 nm.

Aluminium

Aluminium in the soil sample was analysed by Atomic Absorption Spectrophotometer. Al was present in dissolved form in the sample so it was treated with hydrochloric acid. Then, it was filtered and aspirated in the atomizer for the analysis of Al.

Water holding capacity

Water holding capacity of the soil was measured by Keen box method (Keen and Raczkowski, 1921). Filter paper was placed in the bottom of the box and soil was filled upto the top of the box. The weight of the box was measured. The box has pores in the bottom and it is placed in distilled water for overnight. The weight of the wet soil was also measured to determine the water holding capacity of soil.

Cation exchange capacity factor

Fine soil was taken for the analysis of cation exchange capacity. Sodium acetate was added and the mixture was shaked and centrifuged. The liquid was decanted and this process was repeated thrice. Then isopropyl alcohol was added and the mixture was shaked and centrifuged. The liquid was decanted and this process was repeated twice. Then, ammonium acetate was added and the mixture was shaked and centrifuged. The liquid was decanted in 100ml volumetric flask and this process was repeated twice.The combined washing in the volumetric flask was diluted to 100 ml and measured in Flame photometer (Chapman, 1965).

Statistical Analysis

Statistical analysis of soil parameters was performed using MS Excel. The average, median, standard deviation, kurtosis and skewness was calculated for the following soil parameters – pH, EC, N, P, K, CECF, WHC, Fe, Mn, Al and B.

Results and Discussion

pH

pH of the soil is one of the most important parameter because it influences the biological and chemical activities. The pH of soil ranged from 6.56 to 8.7 with mean value of 7.54±0.33 as shown in Figure 1. The soil is neutral to moderately alkaline in nature. Various kinds of nutrients are provided by soil for the proper growth of plants. Change in pH of soil alters the nutrient availablility in soil. Deficiency in nutrients also causes reduction in yield of crops (Lelago *et al.,* 2016). In Bhuapur, minimum pH was recorded as 6.71 and 6.56 at soil depth of 0-15 cm and 15-30 cm respectively which is almost neutral. Highest pH of 8.2 and 8.7 was observed in Mandhawali at 0-15cm and 15-30 cm respectively. This might be due to the presence of basic ions in the soil.

Electrical conductivity (EC)

EC describes the extent of salinity in soil like HCO^{3-} ,Na^{+}, Ca^{2+}, Mg^{2+}, SO_4^{2-}, Cl^{-} etc. and $NO^{3"}$and K^{+} in agricultural soil. Variation in EC due to different concentration of salt explains the salinity in soil. While variation of EC in non-saline soil is due to the cation exchange capacity, content and texture of soil (Visconti and De paz, 2016). Other factors influencing the values of EC are permeability of soil, colloids constituents and organic matter in the soil (). In 0-15 cm, EC ranged from 0.204 to 0.391 mS/cm while in 15-30 cm, EC ranged from 0.212 to 0.762mS/cm as shown in Figure 1. The values of EC are less than 2.000mS/cm which mean that the soil is non-saline.

Available Nitrogen

Nitrogen is essential for plant growth and is an important component in chlorophyll, nucleic acid and protein of plant (Tarquis *et al.,* 2014). In 0-15cm,

available nitrogen ranged from 218 to 388 kg/hectare while in 15-30 cm available nitrogen ranged from 212 to 376 kg/hectare as shown in Figure 2. Most of the soil had moderate amount of available nitrogen while in some season for few villages, the nitrogen level was in low category.

Available Phosphorous

Phosphorus is one of the most vital nutrients for majority of crops since it is crucial for optimal production of crops (Patel and Lakdawala, 2013). Studies have used 4-R technique for assistance on choosing the sources of phosphorus fertilizer, methods for application, suitable agronomic char and scheduling for particular crop (Ziadi *et al.*, 2013). In present study, the available phosphorus ranged from 20.5 to 39.7 kg/hectare as shown in Figure 2. The phosphorous content in soil is moderate to high level.

Available potassium

Potassium play significant role in physiological activities in plants and is also responsible for enhancing the quality of crop and showing resistance to adverse conditions (Bruulsema *et al.*, 2012). The average value of potassium in all sites in different months was found to be 191 kg/hectare. All the potassium values were in medium category of potassium in soil. The maximum value was found to be 210.5 kg/hectare and minimum value was 170.6 kg/hectare as shown in Figure 2.

Iron and Manganese

Iron (Fe) and manganese (Mn) are necessary nutrients for proper growth of plant. Both the nutrient show antagonistic behavior such as high iron application will result in low uptake of Mn and vice-versa. Application of high levels of either Fe or Mn is often accompanied by relatively low levels of uptake for the other nutrient (He *et al.*, 2015). Highest concentration of iron was 5.5 ppm in Mujedi at 15-30cm (Figure 1) while for manganese highest concentration was 3.9ppm in Badraula at 0-15cm as shown in Figure 3.

Boron

Boron is one of the micronutrients required for division of cell, transport of sugars and development of seeds. Adsorption of boron is affected by different factors such as carbonates, sesquioxides, pH, manganese oxides, organic matter and clay (Jokar and Ronaghi, 2015). The concentration of boron in our soil sample ranged from 0.51 to 0.97 ppm as shown in Figure 3. Sun *et al.*, (2019) suggested 0.5-2.00 ppm range is ideal for soil (Sarkar *et al.*, 2014)

Aluminium

Aluminium is found in rocks and and its toxicity increases when the pH of soil. In Khera, minimum Al concentration was recorded as 0.06 ppm at soil depth of 15-30cm and highest Al concentration of 0.39ppm was observed in Mandhawali at 15-30cm

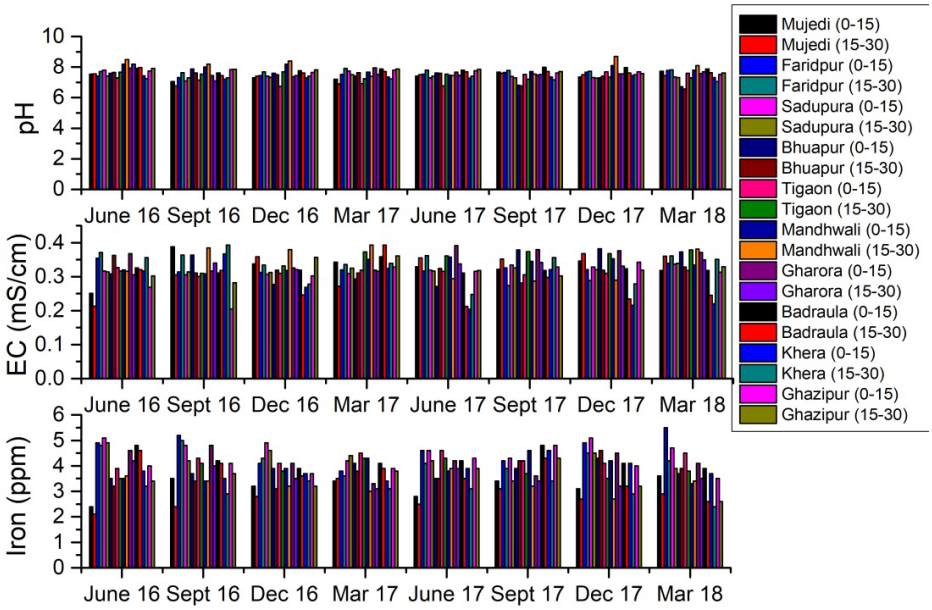

Fig. 1. Value of pH, EC and iron in ten different villages.

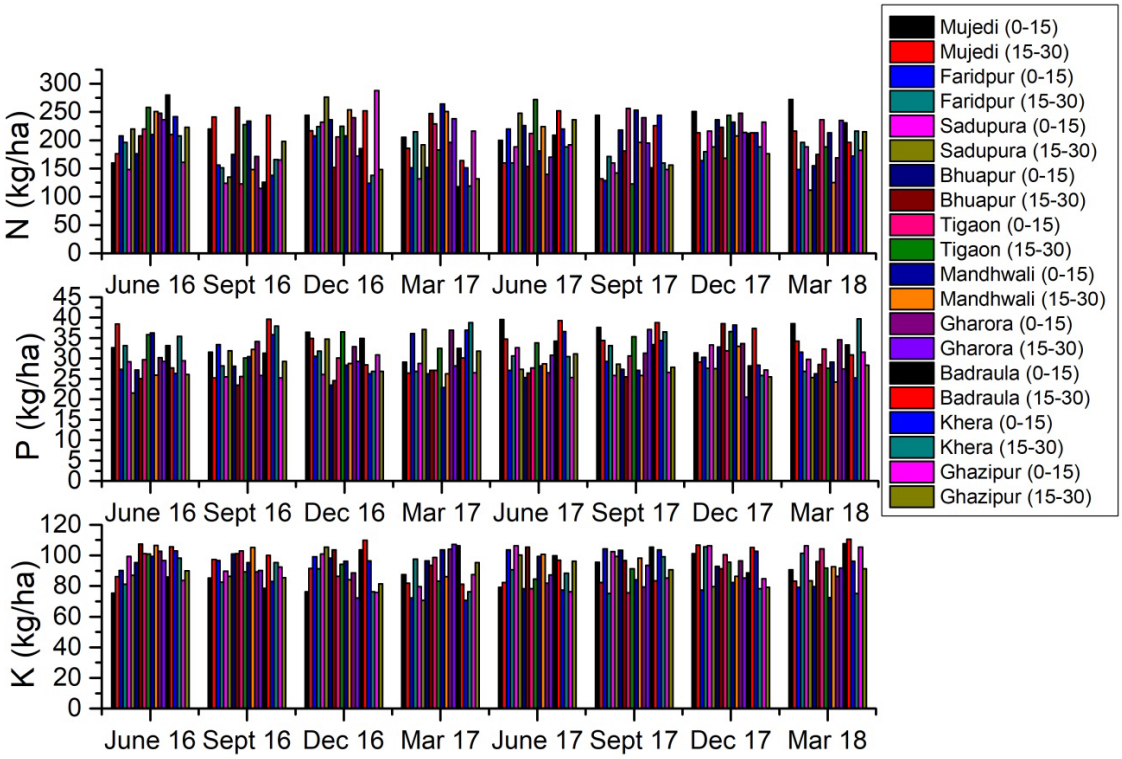

Fig. 2. Value of N, P and K in ten different villages.

as shown in Figure 3.Aluminium concentration of all soil samples were within 2ppm which did not cause any toxicity.

Water Holding Capacity

Water holding capacity (WHC) is the ability of soil for holding the water for crop's usage. Organic matter present in soil and the texture of soil influences the water holding capacity. The value of WHC in soil ranged from 30.2 to 45.6% as shown in Figure 4. In Sadupura, minimum WHC of 30.2% was found at 0-15cm while in Tigaon at 15-30cm, maximum WHC of 45.6% was observed.

Cation exchange capacity (CEC)

CEC of soil describes the capacity of soil holding the exhangeable positive ions such as K^+, Na^+, Mg^{2+} and $Ca^{2+}$by electrostatic attraction (Khaledian et al., 2017). Lowest CEC value 21.6 milliequivalent/ 100gm was observed in Faridpur at (15-30cm) while highest CEC value 32.6 milliequivalent/100 gm was observed in Mujedi (15-30cm) as shown in Figure 4.

Table 1. Statistical analysis of soil parameters

	Average	Median	Standard Deviation	Kurtosis	Skewness
pH	7.54	7.54	0.33	1.4	0.03
EC	0.32	0.32	0.03	1.1	-0.7
N	197.25	205.5	41.71	-0.8	-0.15
P	30.48	29.95	4.33	-0.7	0.3
K	91.89	91.95	10.19	-1.0	-0.1
CECF	26.81	26.57	2.49	-0.6	0.03
WHC	36.99	36.8	3.42	-0.6	0.2
Fe	3.84	3.9	0.64	-0.2	-0.13
Mn	2.52	2.5	0.66	-0.5	-0.03
Al	0.2	0.2	0.067	-0.4	0.3
B	6.77	6.69	1.53	-0.02	-0.1

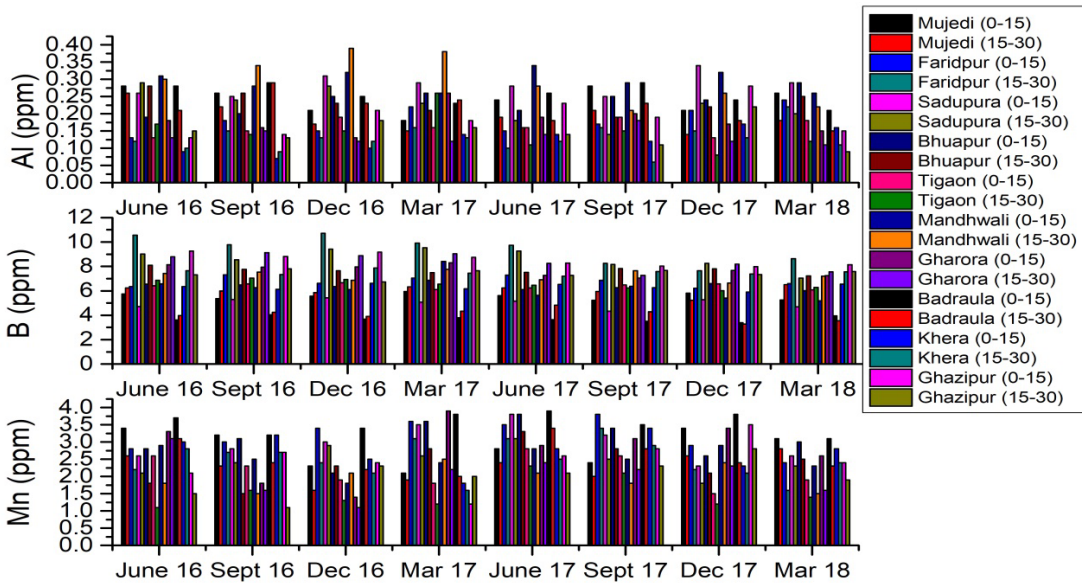

Fig. 3. Value of Mn, B and Al in ten different villages from June 2016 to March 2018

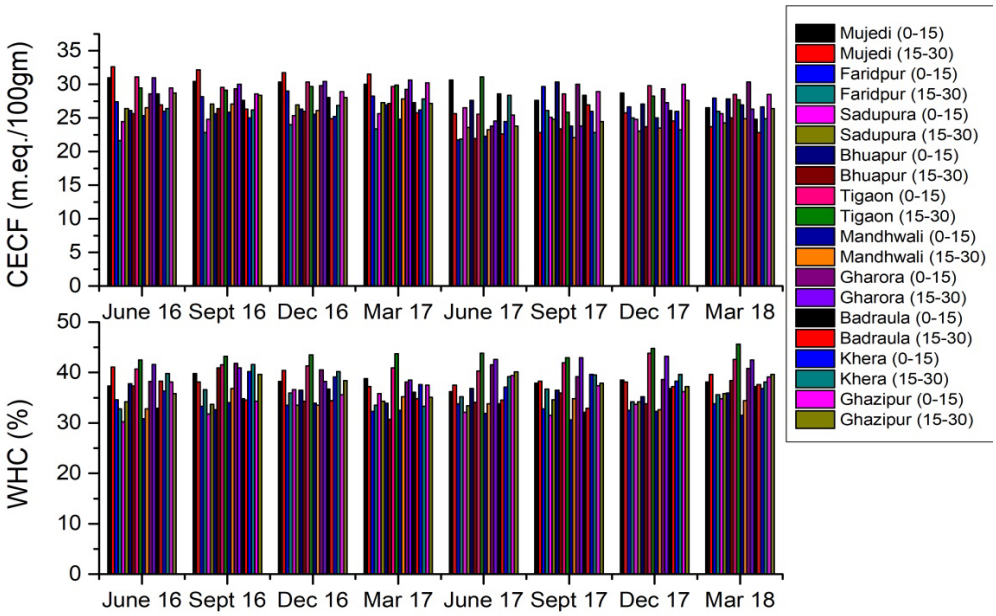

Fig. 4. Value of CECF and WHC in ten different villages from June 2016 to March 2018

Conclusion

The present study of assessing the physicochemical properties in Faridabad region revealed that the soil possess good qualities for the growth of rice and wheat crop. There has been spatial and temporal variation slightly in soil properties of different villages of Faridabad. pH of the soil is mainly neutral in nature. The value of macronutrients NPK in soil was found in the optimal category which resulted in sufficient absorption of other micronutrients in soil. Water holding capacity was found to be appropriate in the soil samples required for crops use. CEC of soil samples indicate that the soil are silty clayey loamy in texture. Aluminium and boron were found to be in non-toxic levels for crops. The micronutrients such as Fe and Mn were found in moderate levels in soil. The soil properties changes with time

therefore this study was done in different seasons to understand the quality of soil. This will help in improving the overall agriculture economy in our country. It is important to study the properties of soil for proper growth and good yield of crops. This will help in improving the overall agriculture economy in our country.

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