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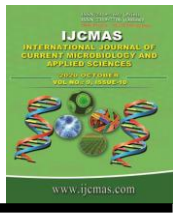

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# Assessment of Chemical Properties of Soil in Chaka Block Prayagraj District, India

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**A B S T R A C T**

An assessment of chemical properties of soil in Chaka block Prayagraj, Uttar Pradesh was carried out in 2019-20. Six sampling points in different villages were selected for the analysis. Soil samples were collected at depths of 0-15, 15-30 and 30-45 cm. The chemical properties found in this region are varied from place to place. The study revealed that range of pH from 7.05 to 7.69, EC range from 0.19 to 0.45 dS $m^{-1}$, organic carbon range from 0.43 to 0.56 %, organic matter range from 0.73 to 0.96 %, nitrogen range from 279 to 260 kg $ha^{-1}$, phosphorus range from 15.11 to 18.12 kg $ha^{-1}$, potassium range from 150.22 to 225.21 kg $ha^{-1}$. The sulphur range from 8.00 to 11.80 kg $ha^{-1}$; during the course of investigation responded appropriate chemical properties which were suitable of crops production in Chaka block of Prayagraj.

## Introduction

Soil is the dynamic link between the biosphere and lithosphere and constitutes a practically non-renewable (very low rate of formation) natural resource, with a key role for the environment and for the agriculture (Moraetis *et al.*, 2016). Soil can develop from weathered rocks, volcanic ash deposits or accumulated plant residues. Soil thus form a substrate for plant growth which performs many functions essential to life and in general, most plants grow by absorbing nutrients from the soil whose ability to do this depends on the nature of the soil (Pujar *et al.*, 2012). Soil is a dynamic natural body developed as a result of pedogenic processes through weathering of rocks, consisting of mineral and organic constituents, possessing definite chemical, physical, mineralogical and

biological properties, having a variable depth over the surface of the earth, and providing a medium for plant growth **(**Thakre *et al.*, 2012). Soil is a complex system comprised of minerals, soil organic matter, water, and air (Vishal *et al.,* 2009). Soil is essential for the development of most plants providing physical support and nutrients. Plants are anchored in the soil by their roots. Nutrients dissolve in soil water which is necessary for the plants growth. Soils contain various organic matters, including dead minerals from plants and animals as well as organisms that choose to live in soil. Soil is a store of various nutrients such as carbon and nitrogen which plays an important role in the global nutrient cycles in hydrological cycles and atmospheric system (Hiscox, 2004). The texture, structure, colour etc. are important soil physical parameters. Similarly, soil reaction (pH), organic matter, macro and micronutrients etc. are also important soil chemical parameters. These properties play important role for the soil fertility and determined after soil testing (Brady and Weil, 2004).

## Materials and Methods

### Site details

The district Prayagraj is located at 25.45° N latitudes and 81.84° E longitudes. It covers an area of 5482 $km^2$. This district lies in the southern part of the state in the Gangetic plain and adjoining Vindhyan Plateau ofIndia. Prayagraj district is surrounded by district Bhadohi and Mirzapur in the East, Kaushambi and Banda in the west, Pratapgarh and Jaunpur in the North and Banda and Madhya Pradesh are in the south. River Ganga and Yamuna flow through the district. The district comprises of eight tahsils, namely Sadar, Soraon, Phulpur, Handia, Bara, Karchana, Koraon and Meja. Tahsil Meja is biggest one according to the area while as per population, Tahsil Sadar is the biggest Tahsil of the district. It has 20 development Blocks, 2802 villages and 10 towns. The climate of Prayagraj district is typical humid subtropical as experienced by the whole north-central India. Prayagraj experiences different seasons with climate varying from extreme hot to extreme cold. It has three seasons: hot dry summer, warm humid monsoon and cool drywinter. The winter usually extends from mid-November to February and is followed by the summer which continues till about the middle of June, experiences severe fog in January resulting in massive traffic and travel delays. The summer season is long and hot with the maximum temperatures ranging from 40°C to 45°C accompanied by hot local winds called as "Loo". The south-west monsoon then ushers in the rainy season providing relief to the hot summer climatic which lasts till the end of September. The months of October and the first half of November constitute the post-monsoon season. The rainfall of Prayagraj district generally decreases from the southeast to the northwest. The monsoon season starts from mid of June to September. About 88 percent of the annual rainfall is received during the monsoon season July and August being the months of maximum rainfall. The annual rainfall in the district is 978 mm.

### Soil sampling

For the purpose of this study samples were collected with the help of khurpi, spade, auger and meter scale from southern part of Prayagraj district (Yamunapar) Chaka Block. Total Eighteen soil samples were collected from the six villages three depths (0-15cm), (15-30cm) and (30-45cm) the sampling site are represented in fig. 1 (Table 1).

## Results and Discussion

As depicted in table 2 and fig. 2 the soil pH statistical accumulation on soil pH of soil

various villages. Significant difference was found due to depth and significant difference was found due to site. The soil pH ranges was found 7.05 to 7.69 the maximum value is found in (30-45 cmdepth) Sringapur ($V_5$) 7.69 and the minimum value is found in (0-15 cm depth) Dhanua ($V_1$) 7.05. As depicted in table 2 and fig. 2 the soil EC (dS $m^{-1}$) statistical accumulation on soil EC (dS $m^{-1}$) of soil various villages. No Significant difference was found due to depth and significant difference was found due to site. The soil electrical conductivity ranges was found 0.19 to 0.45 the maximum soil EC is found in (0-15 cm depth) Babupur ($V_2$) 0.45 and the minimum soil EC found in (15-30 cm depth) Mohiddinpur ($V_3$) 0.19. Similar results were reported by Tripathi and Misra (2012)**.**

**Table.1** Soil chemical properties and their respective methods for analysis

| S. No. | Parameters | Unit | Methodology | Scientist's |
|---|---|---|---|---|
| **1** | Soil pH (1:2) | - | Digital pH Meter | **Jackson, 1958** |
| **2** | Soil EC (1:2) | dS $m^{-1}$ | Digital Conductivity Meter | **Wilcox, 1950** |
| **3** | Organic carbon | % | Rapid titration | **Walkley, 1947** |
| **4** | Organic matter | % | %OM = %OC× 1.724 | **Van Bemmelen Factor** |
| **5** | Available nitrogen | kg $ha^{-1}$ | Alkaline potassium Permanganate | **Subbiah and Asija, 1956** |
| **6** | Available phosphorus | kg $ha^{-1}$ | Spectrophotometric | **Olsen *et al.*, 1954** |
| **7** | Available potassium | kg $ha^{-1}$ | Flame Photometric | **Toth and Prince, 1949** |
| **8** | **Available Sulphur** | **ppm** | **Turbidimetric** | **Chesnin and Yien, 1950** |

**Table.2** Soil pH and Soil EC (dS $m^{-1}$) at different depths (cm) and villages of Chaka block prayagraj

| | Soil pH | | | Soil EC | | |
|---|---|---|---|---|---|---|
| **VILLAGE** | **0-15** | **15-30** | **30-45** | **0-15** | **15-30** | **30-45** |
| **Dhanua ($V_1$)** | 7.05 | 7.20 | 7.23 | 0.32 | 0.37 | 0.40 |
| **Babupur ($V_2$)** | 7.22 | 7.35 | 7.49 | 0.45 | 0.38 | 0.41 |
| **Mohiddinpur($V_3$)** | 7.32 | 7.43 | 7.52 | 0.24 | 0.19 | 0.21 |
| **Dadupur ($V_4$)** | 7.30 | 7.48 | 7.66 | 0.32 | 0.37 | 0.42 |
| **Sringapur ($V_5$)** | 7.25 | 7.32 | 7.69 | 0.29 | 0.33 | 0.39 |
| **Champatpur ($V_6$)** | 7.32 | 7.36 | 7.54 | 0.27 | 0.24 | 0.31 |
| **Mean** | 7.24 | 7.35 | 7.52 | 0.31 | 0.31 | 0.35 |
| | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** |
| **Due to depth** | S | 0.139964 | 0.0000986 | NS | 0.024552 | 0.099002 |
| **Due to site** | S | 0.112317 | 0.002193 | S | 0.072809 | 0.000424 |

**Table.3** Soil Organic carbon (%) and Soil Organic matter (%) at different depths (cm) and villages of Chaka block prayagraj

| | Soil Organic Carbon (%) | | | Organic Matter (%) | | |
|---|---|---|---|---|---|---|
| **VILLAGE** | **0-15** | **15-30** | **30-45** | **0-15** | **15-30** | **30-45** |
| | | | | | | |
| **Dhanua ($V_1$)** | 0.56 | 0.54 | 0.51 | 0.96 | 0.92 | 0.87 |
| **Babupur ($V_2$)** | 0.49 | 0.47 | 0.45 | 0.84 | 0.80 | 0.77 |
| **Mohiddinpur($V_3$)** | 0.48 | 0.45 | 0.43 | 0.82 | 0.77 | 0.73 |
| **Dadupur ($V_4$)** | 0.53 | 0.49 | 0.47 | 0.91 | 0.84 | 0.80 |
| **Sringapur ($V_5$)** | 0.47 | 0.43 | 0.43 | 0.80 | 0.73 | 0.73 |
| **Champatpur ($V_6$)** | 0.51 | 0.45 | 0.44 | 0.87 | 0.77 | 0.75 |
| **Mean** | 0.50 | 0.47 | 0.45 | 0.86 | 0.80 | 0.77 |
| | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** |
| **Due to depth** | **S** | 0.02637 | 0.00000481 | **S** | 0.046736 | 0.00000236 |
| **Due to site** | **S** | 0.034037 | 0.00000171 | **S** | 0.05928 | 0.00000097 |

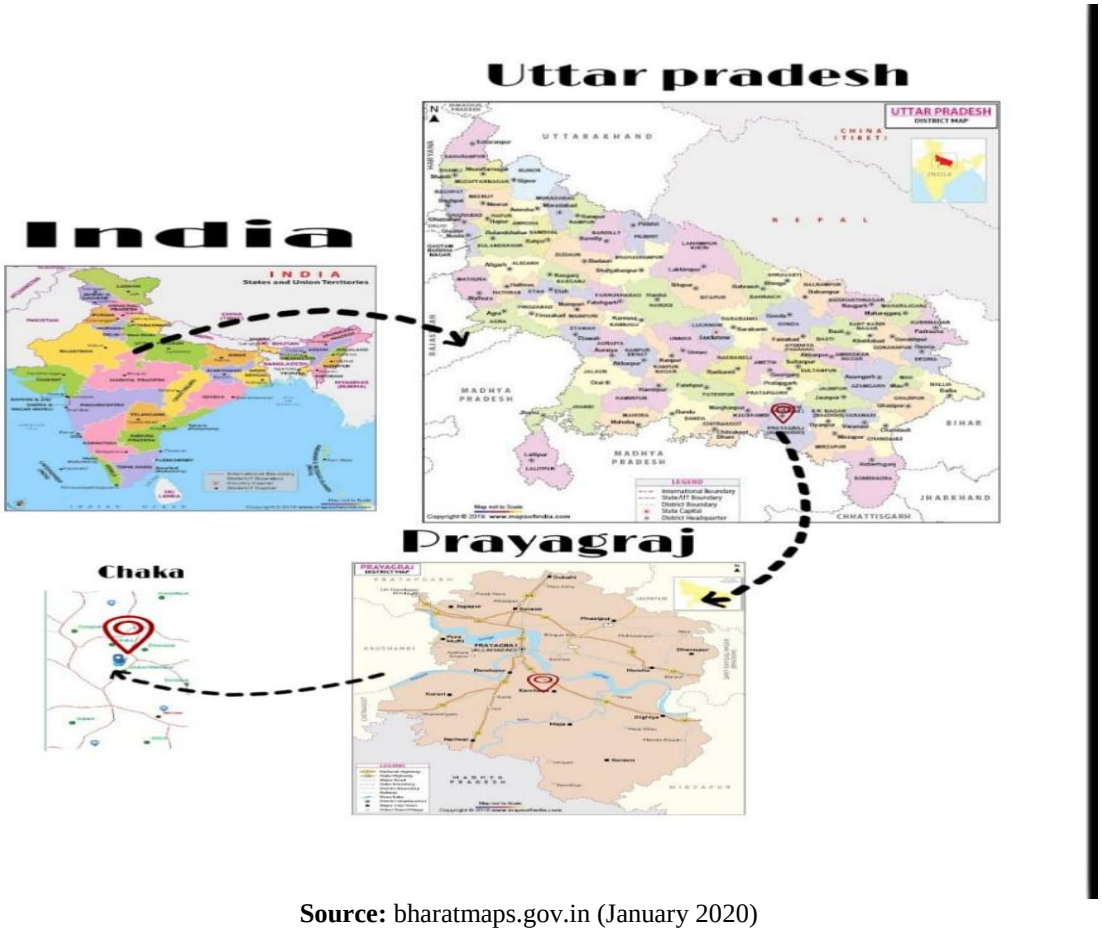
**Table.4** Available NPK (kg $ha^{-1}$) at different depths (cm) and villages of Chaka block Prayagraj

| | Available Nitrogen (kg $ha^{-1}$) | | | Available Phosphorus (kg $ha^{-1}$) | | | Available Potassium (kg $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE** | **0-15** | **15-30** | **30-45** | **0-15** | **15-30** | **30-45** | **0-15** | **15-30** | **30-45** |
| **Dhanua ($V_1$)** | 279.00 | 270.00 | 267.00 | 17.92 | 16.30 | 15.65 | 165.21 | 161.29 | 150.22 |
| **Babupur ($V_2$)** | 277.00 | 269.00 | 260.00 | 17.82 | 16.35 | 15.37 | 220.70 | 173.56 | 169.31 |
| **Mohiddinpur ($V_3$)** | 275.00 | 272.00 | 267.00 | 16.20 | 15.27 | 14.26 | 192.14 | 188.17 | 175.21 |
| **Dadupur ($V_4$)** | 268.00 | 263.00 | 257.00 | 18.12 | 16.31 | 15.11 | 225.21 | 212.65 | 193.33 |
| **Sringapur ($V_5$)** | 269.00 | 265.00 | 260.00 | 17.82 | 16.46 | 15.21 | 216.70 | 195.12 | 188.56 |
| **Champatpur ($V_6$)** | 270.00 | 267.00 | 259.00 | 17.20 | 16.21 | 15.32 | 191.32 | 188.54 | 175.65 |
| **Mean** | 273.00 | 267.66 | 261.66 | 17.51 | 16.15 | 15.15 | 201.88 | 186.55 | 175.38 |
| | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** |
| **Due to depth** | S | 5.669934 | 0.00000428 | S | 1.184738 | 0.000000042 | S | 13.30405 | 0.002071 |
| **Due to site** | S | 3.804481 | 0.000537 | S | 0.519494 | 0.0003314 | S | 17.38439 | 0.002022 |

**Table.5** Available Sulphur (ppm) at different depths (cm) and villages of Chaka block Prayagraj

| | Available Sulphur (ppm) | | |
|---|---|---|---|
| **VILLAGE** | **0-15** | **15-30** | **30-45** |
| **Dhanua ($V_1$)** | 10.25 | 9.30 | 8.95 |
| **Babupur ($V_2$)** | 9.10 | 8.45 | 8.25 |
| **Mohiddinpur($V_3$)** | 12.30 | 10.55 | 9.60 |
| **Dadupur ($V_4$)** | 12.10 | 11.80 | 9.90 |
| **Sringapur ($V_5$)** | 10.30 | 9.10 | 8.65 |
| **Champatpur ($V_6$)** | 9.65 | 8.80 | 8.00 |
| **Mean** | 10.61 | 9.66 | 8.89 |
| | | | |
| | **F-test** | **S.Ed. (±)** | **C.D.at 0.05%** |
| **Due to depth** | S | 0.863978 | 0.000119 |
| **Due to site** | S | 1.081704 | 0.0000651 |

**Fig.1** Location map of study area Chaka, Prayagraj, U.P.




**Source:** bharatmaps.gov.in (January 2020)

**Fig.2** Soil pH and Soil EC (dS $m^{-1}$) at different depths (cm) and villages of chaka block prayagraj

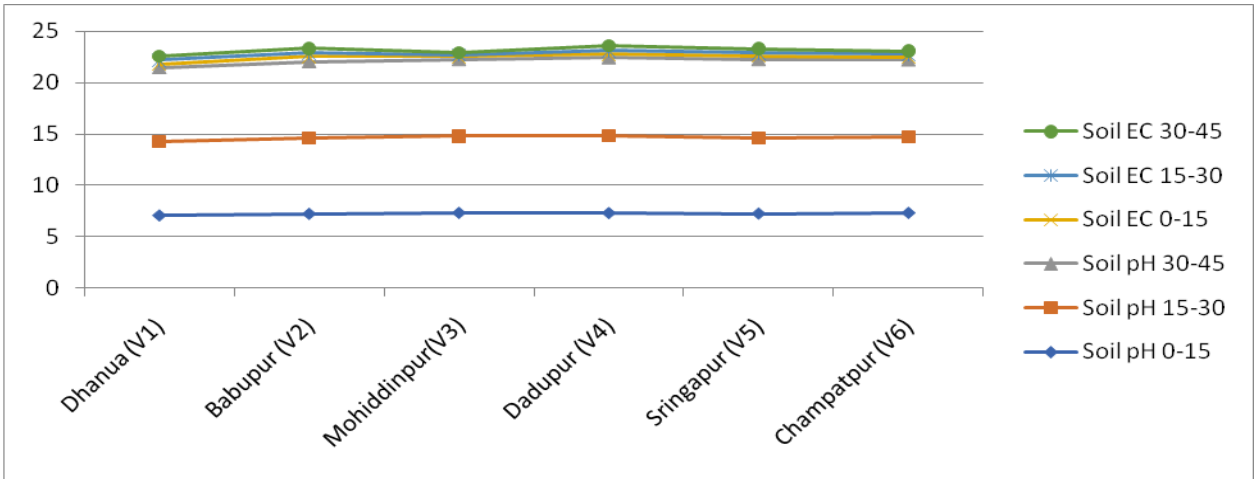



**Fig.3** Soil Organic carbon (%) and Soil Organic matter (%) at different depths (cm) and villages of Chaka block prayagraj

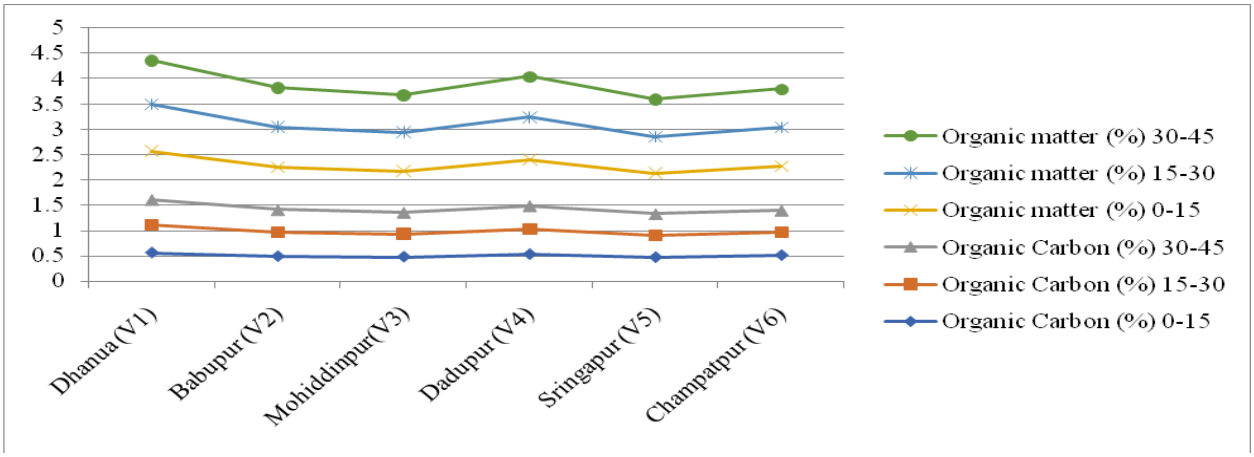



**Fig.4** Available NPK at different depths (cm) and villages of Chaka block Prayagraj

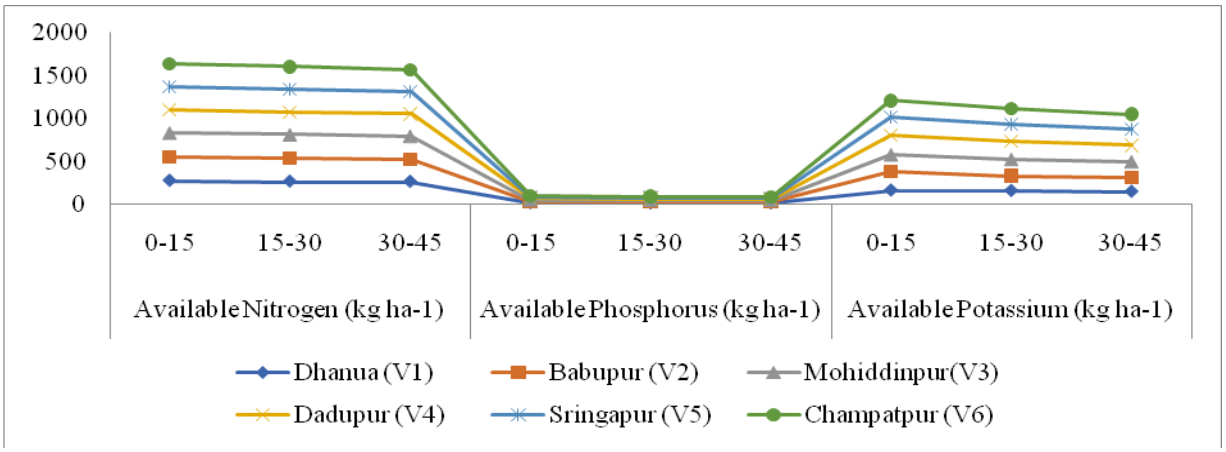
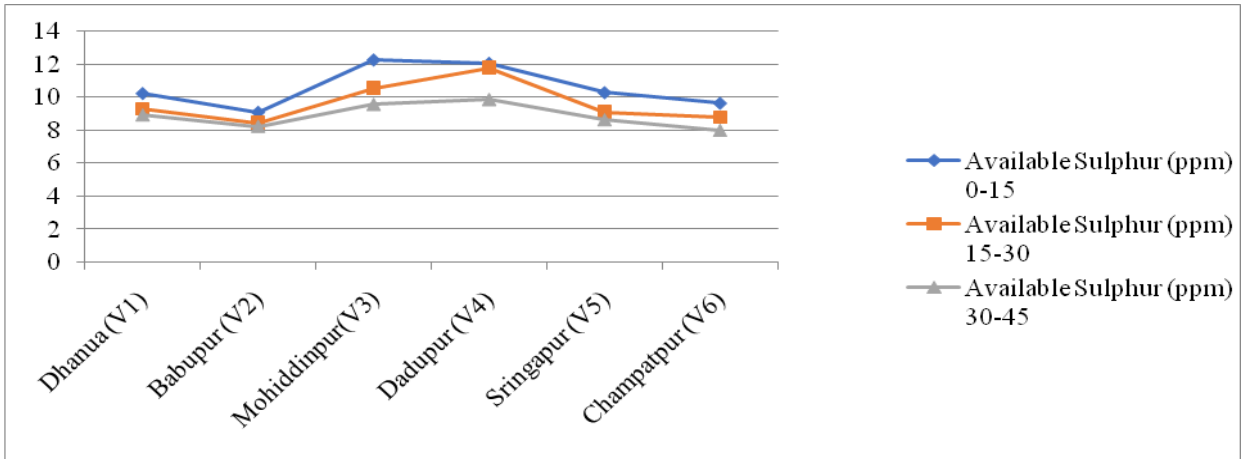


**Fig.5** Available Sulphur (ppm) at different depths (cm) and villages of Chaka block Prayagraj




As depicted in table 3 and fig. 3 the organic carbon (%) statistical accumulation on organic Carbon (%) of soil various villages. Significant difference was found due to depth and significant difference was found due to site. The soil organic carbon (%) ranges was found 0.43 to 0.56 (%) the maximum value is found in (0-15 cm depth) Dhanua ($V_1$) 0.56 and the minimum value is found in (30-45 cm depth) Mohiddinpur ($V_3$), Sringapur ($V_5$) 0.43 (%). As depicted in table 3 and fig. 3 the organic matter (%) statistical accumulation on soil organic matter (%) of soil various villages. Significant difference was found due to depth and significant difference was found due to site. The soil organic matter (%) ranges was found 0.73 to 0.96 (%) the maximum value is found in (0-15 cm depth) Dhanua ($V_1$) 0.96 and the minimum value is found in (30-45 cm depth) Mohiddinpur ($V_3$), Sringapur ($V_5$) 0.73 (%), similar results was reported by Verma *et al.*, (2019).

As depicted in table 4 and fig. 4 the available Nitrogen (kg $ha^{-1}$) statistical accumulation on available nitrogen (kg $ha^{-1}$) in soils of various villages. Significant difference was found due to depth and significant difference was found due to site. The available nitrogen (kg $ha^{-1}$) in soils ranges was found 266.00 to 279.00 (kg $ha^{-1}$) the maximum value is found in (0-15 cm depth) Dhanua ($V_1$) 279.00 and the minimum value found in (30-45 cm depth) Babupur ($V_2$), Sringapur ($V_5$) 260.00 (kg $ha^{-1}$). As depicted in table 4 and fig. 4 the available phosphorus (kg $ha^{-1}$) statistical accumulation on available phosphorus (kg $ha^{-1}$) in soil of various villages. Significant difference was found due to depth and significant difference was found due to site. The available phosphorus (kg $ha^{-1}$) in soils ranges was found 14.26 to 17.92 (kg $ha^{-1}$) the maximum value is found in (0-15 cm depth) Dadupur ($V_4$) 18.12 and the minimum value is found in (30-45 cm depth) Mohiddinpur ($V_3$) 14.26(kg $ha^{-1}$). As depicted in table 4 and fig. 4 the available potassium (kg $ha^{-1}$) statistical accumulation on available potassium (kg $ha^{-1}$) in soil of various villages. Significant difference was found due to depth and significant difference was found due to site. The available potassium (kg $ha^{-1}$) in soil ranges was found 150.22 to 225.21 (kg $ha^{-1}$) the maximum value is found in (0-15 cm depth) Dadupur ($V_4$) 225.21 and the minimum value is found in (30-45 cm depth) Dhanua ($V_1$) 150.22 (kg $ha^{-1}$). Similar results was reported by Madhu and David (2017)

As depicted in table 5 and fig. 5 the available sulphur (ppm) statistical accumulation on available sulphur (ppm) in soil of various

villages. Significant difference was found due to depth and significant difference was found due to site. The available sulphur (ppm) in soil ranges was found 8.00 to 12.30 (kg $ha^{-1}$) the maximum value is found in (0-15 cm depth) Mohiddinpur ($V_3$) 12.30 and the minimum value found in (30-45 cm depth) Champatpur ($V_6$) 8.00 (ppm).

It was concluded from the trail that fields of different villages of Chaka block, Prayagraj district, U.P., gave the best findings in terms of soil heath were in the ($V_1$) Dhanua > ($V_2$) Babupur > ($V_3$) Mohiddinpur > ($V_5$) Sringapur > ($V_4$) Dadupur > ($V_6$) Champatpur respectively and maximum (sulphur) was found in the ($V_3$) Mohiddinpur > Dadupur ($V_4$) > ($V_5$) Sringapur > ($V_1$) Dhanua > ($V_6$) Chamapatpur > ($V_2$) Babupur respectively. Based on the results ($V_1$) Dhanua, gave the best results of soil health parameters and was found most suitable for cultivation of Wheat, Rice, Gram, Pea, Mustard, Sorghum, Pearl millet, Potato, Tomato, Brinjal, *etc*., and soil having good soil fertility and productivity but farmers has to sustain soil health parameters and protect their soil from point and non-point pollution sources.

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