

## Physicochemical analysis of soil from agriculture field of Madhepura district

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### ABSTRACT

Physicochemical parameters are most important factors for the agricultural production so it is necessary to evaluate these factors. In the present study, physicochemical parameters of 15 villages under Madhepura district were studied. It was observed that moisture content ranged in between 6.95 % to 12.06 % and E.C. ranged in between 0.34  $\mu\text{mhos/cm}$  to 0.42  $\mu\text{mhos/cm}$ . pH value varied in between 6.5 to 7.4 which indicates that the soil is approximately neutral. Nitrogen content was in between 192.25 kg/ha to 25.36 kg/ha. Minimum nitrogen content was observed in a soil sample of Murliganj. Phosphorus ranged in between 9.78 kg/ha to 32.35 kg/ha. Minimum phosphorus was recorded from a soil sample of Haripur. Potash content of soil ranged in between 189.53 kg/ha to 304.87 kg/ha. Minimum potash content was observed in a soil sample of Gwalpada.

**Key Words** - Physicochemical parameters, pH, Electrical conductivity, Nitrogen, Phosphorus

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### INTRODUCTION

Soil is the natural medium for the growth of plants and it is the unconsolidated minerals mineral matter influenced by environmental factors (Manimengalai and Sukanya, 2014). Soil horizons are minerals constituents of variable thickness differing from parent material in their morphology, physical and biological properties. Soil is composed of broken particles of rock altered by physical and chemical processes. These processes include weathering and erosion. Plants and soil dwelling microbes are directly dependent on soil. Soil perform complex functions for all living beings. It act as filter, buffer storage, medium for plants and soil microbes and transformation system and thus protect global ecosystem against effect of environmental pollution.

The study of physicochemical parameter is important in agriculture for plant growth and management. The physicochemical parameters

such as pH, moisture, soil temperature, nitrogen, phosphorus, carbon, potassium, calcium content of soil directly affect both plants and microbes. Nitrogen, phosphorus and potassium are required for protein synthesis, photosynthesis, DNA-RNA synthesis and other physical as well as chemical activities. Calcium is an essential part of cell wall which provide transport of other elements (Chaudhari, 2013). Plants depends on soil for their nutrition, water and mineral supply.

### MATERIAL & METHODS

**Physicochemical analysis of soil:** Soil samples were collected at regular intervals from different agriculture fields of Madhepura district. Altogether fifteen spots were selected for sample collection. Soil samples were collected in a zig-zag path from each spot. Soil samples were brought to the laboratory in polythene bags. Selected spots for sample collection and soil codes are listed in Table.

1.

**Table 1: List of codes of soil samples collected from different villages**

Village	Soil code
Gwalpada	GWA
Haripur	HAR
Ghelar	GHE
Singheshwar	SIN
Saropatti	SAR
Itehri	ITE
Bhelwa	BHE
Methahi	MET
Shankarpur	SHA
Sukhashan	SUK
Sahugarh	SAH
Murliganj	MUR
Bihariganj	BIH
Chousa	CHO
Kumarkhand	KUM

**Moisture content of soil:** For the determination of moisture content, 10gm soil sample was placed in a pre-weighed crucible and transferred in the oven at a temperature of 105°C for 1 hour. Crucible was taken out and measured on a balance. It was again transferred in the oven at a temperature of 105°C and after one hour it was measured. This process was repeated till constant weight was observed. Moisture content was calculated by the formula:

$$\text{Moisture per gm soil} = \frac{\text{wt. of crucible with moist soil} - \text{wt. of crucible with soil}}{\text{wt. of soil}}$$

**pH:** For the measurement of pH, cystronic pH-meter was used. pH-meter was calibrated. 1gm soil sample was taken in a test tube and 5ml distilled water was added to it. Test tube was shaken and an electrode of pH meter was dipped into it. pH was recorded from digital scale.

**Electrical Conductivity:** E.C. was measured by the method described by Jackson (1967). Soil sample was dried. 10gm dried soil sample was placed in a beaker and 25ml distilled water was added in it. After thorough mixing, electrode of cystronic conductivity meter was immersed in beaker and E.C. was recorded from digital scale of Conductivity meter.

**% Organic Carbon:** For the estimation of % organic carbon, Walkley and Black (1934) method was applied. Following chemicals were needed:

- 1M Pot. Dichromate solution
- Conc.  $\text{H}_2\text{SO}_4$
- o-phosphoric acid
- Sodium fluoride
- Diphenyl amine
- 0.5N ferrous ammonium sulphate (FAS)

**Protocol:** In a conical flask, 1gm dried soil sample was taken and 10 ml potassium dichromate solution was added in it. 20 ml conc. Sulphuric acid was added slowly and the content of the flask was mixed thoroughly. Conical flask was kept undisturbed for about 30 minutes and then 250 ml distilled water was added in the flask. In another conical flask, 10ml potassium dichromate solution and 20ml sulphuric acid were taken and after 30 minutes 250 ml distilled water was added. It was treated as blank. Few drops of diphenyl amine was added in both flasks and titrated against FAS. % organic carbon was calculated by the formula:

$$\% \text{ organic carbon} = \frac{V_b - V_s}{S} \times 0.5 \times 0.39$$

Where,  $V_b$  = Vol. of FAS for blank  
 $V_s$  = Vol. of FAS for sample  
 $S$  = Wt. of soil sample

**Estimation of Nitrogen:** % Nitrogen was estimated by the Kjeldahl method.

Chemicals required:

- Digestion mixture
- Conc. Sulphuric acid
- 0.02N sulphuric acid
- Boric acid solution
- Sodium hydroxide
- Methyl red
- Bromocresol green

**Digestion mixture:** Digestion mixture was prepared by grinding 10gm potassium sulphate and 1gm copper sulphate. Both grinded powder was mixed together.

**Boric acid solution:** For the preparation of Boric acid solution, 4gm Boric acid powder was dissolved in 100ml in warm water.

**Indicator:** Methyl red and Bromocresol were used as indicators.

Kjeldahl method for Nitrogen estimation completed in three steps:

- Digestion
- Distillation
- Titration

**Digestion:** 2gm dried soil sample and 2gm digestion mixtures were placed in the digestion tube of a pipette and 10 ml conc. Sulphuric was added to it. Digestion tube was heated up to 300°C temperature. After completion of digestion, the digestion tube was cooled and the digested mixture was taken out from the digestion tube.

**Distillation:** Digested mixture was kept in the distillation unit and a conical flask containing 20 ml boric acid solution was kept beneath the condenser of distillation unit. After completion of distillation, the conical flask was removed from the condenser. Blank was also prepared in the same way without adding soil sample. Both sample and blank were titrated against 0.02N sulphuric acid. Bromocresol was used as an indicator. Factor of sulphuric acid (0.02N) was calculated by acid base titration where Methyl red was used as an indicator. % Nitrogen was calculated by the formula:

$$\%N = 14.007 \times 0.02 \times F \times \frac{V1 - V2}{SXV3} \times 100$$

Where, F = factor of 0.02N sulphuric acid

V1 = Volume of titrant

V2 = Volume of blank

V3 = Total volume of distilled aliquot

S = Wt. of soil

**Estimation of Phosphorus:** Phosphorus was estimated by Olsen's method (Olsen *et al.*, 1954). 5gm dried soil sample was taken in a conical flask and 100 ml 0.5N sodium bicarbonate solution was added followed by one teaspoon active charcoal. Suspension was shaken for 30 minutes and filtered through Whatman filter paper no. 41. 10ml filtrate

was taken in a volumetric flask of 50 ml and volume was adjusted to 50ml by adding distilled water. One drop of indicator (paranitrophenol) was added and pH adjusted to 3 by adding 4N HCl. 0.1N stannous chloride (5 drops) were added and shaken vigorously.

**Preparation of Blank:** 0.5N sodium bicarbonate was taken as blank.

**Standard solution:** Standard solution of  $P_2O_5$  was prepared by dissolving 2.83gm  $P_2O_5$  in 10 ml distilled water. In standard solution paranitrophenol indicator and 0.1N stannous chloride solution were added to develop color.

**Optical density:** Optical density of blank, sample and standard solution were taken at 660 nm wavelength on a Spectrophotometer. Phosphorus was calculated by the formula:

$$\text{Available P in } \frac{\text{mg}}{\text{gm}} \text{ soil} = \frac{\text{OD of sample} - \text{OD blank}}{\text{OD st.} - \text{OD blank}} \times \frac{2}{10 \times 5}$$

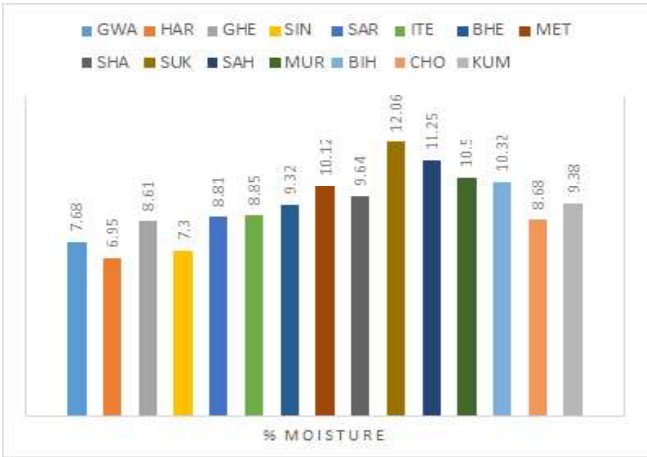
Value was further converted to Kg/ha.

**Estimation of Potassium:** Available potassium was estimated by flame photometer. 5gm soil sample was taken in a beaker and 25 ml 1M ammonium acetate added in it. Suspension was vigorously shaken. Suspension was filtered through Whatman filter 25ml. Distilled water was added and automated to the flame photometer. Result was obtained in mg/L which was converted to Kg/ha.

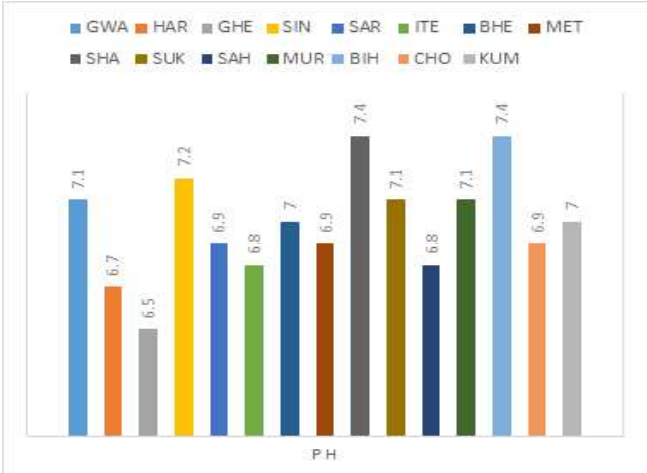
## RESULT

Physico-chemical parameter of soil samples collected from different places were examined. The soil samples were prescribed codes which is mentioned in Material & Methods and Results also. The percentage moisture content was observed maximum in soil code SUK collected from Sukhasan (12.06%) and minimum percentage moisture content was observed in soil sample code HAR collected from Haripur (6.95%). pH ranged in between 6.5 to 7.4 in different soil samples. Minimum pH was observed in soil sample GHE collected from Ghelar and maximum pH was observed in soil sample code SHA and BIH collected from Shankarpur and Bihariganj respectively. The value of electric conductivity ranged from 0.34

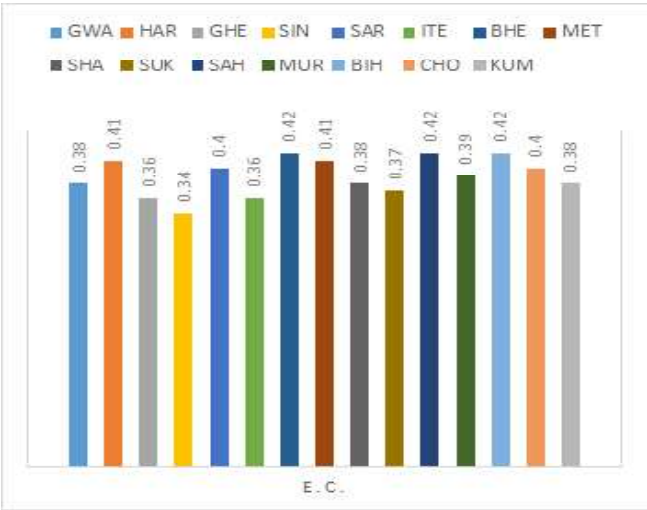
$\mu\text{mhos/cm}$  to  $0.42 \mu\text{mhos/cm}$ . Minimum E.C. was observed in soil code SIN collected from Singheshwar and maximum value of E.C. was observed in soil sample code BHE, BIH and SAH collected from Bhelwa, Biharigang and Sahugarh respectively. Nitrogen content in different soil samples varies from  $192.25 \text{ kg/Ha}$  to  $253.36 \text{ kg/Ha}$ . Minimum nitrogen content was observed in soil sample code MUR collected from Murliganj and maximum nitrogen content was observed in soil sample code BHE collected from Bhelwa. Phosphorus content varied from  $9.78 \text{ kg/Ha}$  to  $32.35 \text{ kg/Ha}$ . Minimum phosphorus content was observed in soil sample code HAR collected from Haripur and maximum in soil sample code MUR collected from Murliganj. The Potash content ranged from



Graph 1: Percentage moisture content of soil samples



Graph 2: pH value of soil samples



Graph 3: E.C. value of soil samples

Table 2: Physico-chemical analysis of soil samples

Village	Soil code	Nitrogen (kg/Ha)	Phosphorus (kg/Ha)	Potash (kg/Ha)
Gwalpada	GWA	240.35	11.54	189.53
Haripur	HAR	230.45	9.78	304.87
Ghelar	GHE	215.63	17.35	280.73
Singheshwar	SIN	213.83	15.73	218.15
Saropatti	SAR	240.54	18.67	237.67
Itehri	ITE	233.87	28.53	282.83
Bhelwa	BHE	253.36	27.69	192.53
Methahi	MET	236.45	17.89	198.78
Shankarpur	SHA	213.87	13.35	222.35
Sukhashan	SUK	218.53	14.73	235.73
Sahugarh	SAH	216.64	19.96	252.87
Murliganj	MUR	192.25	32.35	255.53
Bihariganj	BIH	228.73	28.73	247.78
Chousa	CHO	217.65	29.56	234.35
Kumarkhand	KUM	227.73	27.97	232.73

$189.53 \text{ kg/Ha}$  to  $304.87 \text{ kg/Ha}$  in different soil samples. Minimum potash content was observed in soil sample code GWA collected from Gwalpada and maximum potash content was observed in soil sample code HAR collected from Haripur.

DISCUSSION

Soil samples were collected from agriculture field of 15 villages under Madhepura district for physicochemical analysis. Physicochemical parameters including moisture content, pH, electrical conductivity, nitrogen, phosphorus and potash content of soil were tested. In present study, pH value of soil samples ranged in between 6.5 to

7.4 indicating that the soil of villages under examination was neither acidic nor alkaline and hence is suitable for different crops. Nitrogen content ranged in between 192.25kg/ha to 25.36kg/ha. Minimum nitrogen content was observed in a soil sample of Murliganj. Phosphorus ranged in between 9.78kg/ha to 32.35kg/ha. Minimum phosphorus was recorded from a soil sample of Haripur. Potash content of soil ranged in between 189.53kg/ha to 304.87kg/ha. Minimum potash content was observed in a soil sample of Gwalpada. Sharma *et al.* (2017) examined the physicochemical parameters of soil from Ladpura Tehsil under Kota district of Rajasthan and observed that the nutrient condition of soil was sufficient for crop production. In the present study also it was observed that the nitrogen, phosphorus and potash content of examined soil were sufficient for crop production. Akram *et al.* (2014) studied the soil fertility and salinity of Muzaffargarh district (Pakistan) and reported that 94% soil samples were not saline and 74% soil samples were not acidic. In the present study, it was observed that 100% soil samples were neither alkaline nor acidic (pH-6.5 to 7.4).

## CONCLUSION

Soil samples were collected from agriculture field of 15 villages under Madhepura district. Physicochemical parameters including moisture, pH, E.C., nitrogen, phosphorus and potash were tested in soil samples. It was observed that moisture content ranged in between 6.95% to 12.06% and E.C. ranged in between 0.34  $\mu\text{mhos/cm}$  to 0.42  $\mu\text{mhos/cm}$ . pH value varied in between 6.5 to 7.4 which indicates that the soil is approximately neutral. Nitrogen content was in between 192.25 kg/ha to 25.36 kg/ha. Minimum nitrogen content was observed in a soil sample of Murliganj. Phosphorus ranged in between 9.78 kg/ha to 32.35 kg/ha. Minimum phosphorus was recorded from a soil sample of Haripur. Potash content of soil ranged in between 189.53 kg/ha to 304.87 kg/ha. Minimum potash content was observed in a soil sample of Gwalpada.

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