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Impact of Brick Kiln emission on physico-chemical properties of soil in agriculture field of Madhepura

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Abstract- Physico-chemical parameter of soil near brick kiln of Mathahi village of Madhepura district was examined and compared with physico-chemical parameter of soil half km away from brick kiln. It was observed that the pH value was lowest in all directions at 100mt away from brick kiln followed by 50mt away and 150mt away. Electrical conductivity doubled at each spot. Nitrogen content, Phosphorus content and Potash content also decreased near brick kiln. The pH was lowest (5.8) at 100mts away from brick kiln in its east side, pH 5.4 at North and west side and 5.5 in South side. The lowest value of percentage organic carbon in soil was at 100mt away in east side (0.35). Nitrogen was also lower near all spots of brick kiln. The lowest value was observed in east side at 100mt away from brick kiln (42.35kg/Ha). Phosphorus was also lowest at this spot (4.3kg/Ha). The lowest value of Potash was observed at 100mt away from brick kiln in west side (100.6).

Key words: Physico-chemical parameters, Brick kiln, pH, Electrical conductivity

INTRODUCTION

In the manufacturing of Bricks, generally top soil's up to 1.5mt depth is used. Deeper soil removal resulted in drastic loss of soil fertility and the land becoming agriculturally unproductive.[1] This layer of soil consists of organic matter, nutrients and microbes essential for crop production. 50-100 meter distance from Brick kilns soil is affected and is not suitable for cultivation.[2] It was reported that brick kiln alters the soil physico-chemical properties and soil nutrients of its surrounding areas.[3] Deterioration of soil quality, nutrient content and microbial content indicate that Brick kiln is not suitable near agriculture field. The emission of Brick kiln contains heavy metal like Pb, Cr and Ni which severely affect the biodiversity.[4] Accumulation of heavy metals in the soil adversely affect soil texture. Adrees *et al.* (2016)[5] found that concentration of Ni, Pb and Co causes decrease in organic matter content and lower the concentration of Ca, Mg and Na. The electrical conductivity near Brick kiln fields becomes almost double and pH of soil decreases. Saha *et al.* (2021)[6] concluded that the Brick kiln surrounding areas have very low pH and organic matter content. The organic matter content near the soil of Brick kiln significantly lowers than that of soil away from Brick kiln. The organic carbon content surrounding Brick kiln area also decreases.

Brick kilns are considered harmful for the environment. It is largest source of greenhouse gas emission including black carbon, carbon dioxide, sulphur oxides, nitrogen oxides, carbon monoxide and suspended particulate matters as well as fluoride and small amount of carcinogenic substance. Skinder *et al.* (2014)[7] reported that the average emission of gases per 1000 bricks were 6.35

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to 12.3kg of CO, 0.52 to 5.9 kg of SO_2 and 0.64 to 1.4 kg of particulate matter. Brick kilns are major contributor of black carbon. Thygerson & S.J. (2016)[8] reported that Brick kilns contribute about 31% total suspended particles in environmental air pollution. Hossain *et al.* (2019)[9] reported that acid deposit from sulphur oxides and nitrogen oxides emitted from Brick kilns negatively affect agricultural productivity.

MATERIAL & METHOD

For the present study, a brick kiln near Mathahi village of Madhepura district was selected. The brick kiln is nearby state road which passes from Madhepura to Saharsa. The road it situated at 50mts away from the brick kiln in its south side. Soil samples were collected at a distance of 50mts., 100mts. and 150 mts. in four directions (North, South, East, West) around the Brick Kiln at a depth of 0-30cm in Rainy season, summer season and winter season. soil samples were brought to the laboratory for physico-chemical analysis.

Physico-chemical analysis of soil samples:

(a) pH- pH was determined by the method of Jackson (1967). 10gm soil was dissolved in 20ml distilled water and stirred well for 10 minutes. It was kept undisturbed for some time and stirred again. pH was measured by cystronic pH meter.

(b) Electrical conductivity - Electrical conductivity was measured by the method described by Jackson (1967). 10gm soil was dissolved in 20ml distilled water in a beaker and stirred vigorously. The soil water mixture allowed to stand undisturbed till soil settled completely. The E.C was measured using cystronic conductivity meter.

(c) Estimation of Total organic carbon - For the estimation of Total organic carbon, method of Walkley & Black (1934) was applied.

Required Reagents:

i) 1M potassium dichromate
ii) 0.5N ferrous ammonium sulphate
iii) Conc. Sulphuric acid
iv) Ortho-phosphoric acid
v) Sodium fluoride
vi) Di-phenyl amine

Procedure: For the measurement of total carbon, soil samples were dried. 1gm dry soil sample was transferred in a conical flask and 10ml potassium dichromate solution was added in it. Two blanks were also prepared. 20ml conc. sulphuric acid was added in the flask in samples and blanks. It was swirled well and allowed to stand for 30 minutes. 250ml water was added both in sample and blanks. 10ml ortho-phosphoric acid was added and allowed to cool. 1ml di-phenyl amine as indicator was added. It was titrated against ferrous ammonium sulphate solution. Appearance of violet-blue color shows end point. The amount of total organic carbon was calculated by the following formula:

$$\%Carbon = M \times \frac{V1 - V2}{S} \times 0.39$$

Where,

M = Molarity of ferrous ammonium sulphate solution
V1 = Volume of ferrous ammonium sulphate solution for blank
V2 = Volume of ferrous ammonium sulphate solution for sample
S = Weight of soil sample

(d) Estimation of Nitrogen: Nitrogen was estimated by Kjeldahl method.

Required Reagent:

i) Sulphuric acid
ii) Selenium powder
iii) Hydrogen peroxide
iv) Sodium hydroxide
v) Methyl red
vi) Bromocresol green
vii) Boric acid solution
viii) 0.01M Hydrochloric acid

Procedure: 1gm of sieved dry soil sample was added in the digestion tube. 2.5ml digestion mixture was added and 1ml hydrogen peroxide was added in it. The digestion tubes were placed on heater and heated up to 200°C temperature for 1 hour and then temperature was raised to 330°C for about 2 hours. The digestion tube was removed from heater and allowed to cool. A beaker containing 20ml Boric acid indicator solution was placed beneath the condenser tip. 20ml NaOH was added to the digestion tube. The beaker was removed from its place. Condenser tip was rinsed. Distillate was titrated against 0.01M HCl. Appearance of pink color was the end point. The amount of % Nitrogen was calculated by the formula:

$$\%N = \frac{a - b}{s} \times M \times 1.4$$

Where,

N = Nitrogen

a = volume of 0.01M HCl required for titration of sample
b = volume of 0.01M HCl required for titration of blank
M = Molarity of HCl

(e) Estimation of Phosphorus: Phosphorus was estimated by Olsen method. For this purpose, Extracting solution was prepared which contains following chemicals:

Extracting solution:

i) 0.5M Sodium Bicarbonate solution
ii) 4M Sulphuric acid
iii) 4% ammonium molybdate solution
iv) Potassium antimony tartrate solution

Ascorbic acid was used as reagent and standard solution of phosphate is prepared (100mg/L).

Procedure:

i) 5gm fine dry soil sample was added in 100ml distilled water and stirred well.
ii) 100ml extracting solution was added in it.
iii) Mixture was shaked for 30 minutes and filtered through Whatman filter paper No. 42.
iv) 3ml blank, 3ml sample extract and 3ml standard phosphate solution were taken in 3 test tubes.
v) 3ml reagent was added in each test tube and allowed to stand for 1 hour.
vi) A Blue color appears.
vii) OD was measured on Spectrophotometer at 720nm.
viii) Phosphate concentration was measured by the formula:

$$P\left({}^{mg}/_{gm\ of\ soil}\right) = \left(\frac{a-b}{c-b}\right) X \frac{100}{S}$$

Where,

a= OD of sample
b= OD of blank
c= OD of standard solution
s= Sample weight in gm

(f) Estimation of Potassium: Potassium was estimated by the flame photometer. 10ml normal ammonium acetate was added in 1gm dry soil and shaken for 5 minutes. The result is obtained in ppm.

RESULT

Soil samples were collected near Brick kiln at a distance of 50mts, 100mts and 150mts in all directions (North, South, East and West) and half km away from the Brick Kiln. Physico chemical parameter of soil near Brick kiln and half km away from brick kiln were compared. It was observed that the soil pH became acidic near Brick kiln while it was neutral at half km away from brick kiln. The pH was lowest (5.8) at 100mts away from brick kiln in its east side, pH 5.4 at North and west side and 5.5 in South side. Electrical conductivity became almost double at each spot, organic carbon was lower in comparison to the organic carbon in soil at half km away from the brick kiln. The lowest value of percentage organic carbon in soil was at 100mt away in east side (0.35). Nitrogen was also lower near all spots of brick kiln. The lowest value was observed in east side at 100mt away from brick kiln (42.35kg/Ha). Phosphorus was also lowest at this spot (4.3kg/Ha). The lowest value of Potash was observed at 100mt away from brick kiln in west side (100.6). The result is mentioned in Table No. 01 and the result of all soil parameter at half km away from brick kiln is mentioned in

Table 1- Physico-chemical parameter of soil near Brick Kiln

Direction	Distance	pH	E.C. (dsm^{-1})	Organic carbon (%)	N (kg/Ha)	P (kg/Ha)	K (kg/Ha)
East	50mt	6.7	0.52	0.40	44.82	4.8	170.4
	100mt	5.8	0.68	0.35	42.35	4.3	110.6
	150mt	6.3	0.66	0.45	45.62	5.0	140.3
West	50mt	6.2	0.64	0.43	62.68	6.6	140.4
	100mt	5.4	0.50	0.40	58.93	6.2	100.6
	150mt	6.1	0.54	0.47	60.72	6.8	150.5
North	50mt	5.8	0.70	0.45	68.64	6.4	150.3
	100mt	5.4	0.60	0.42	63.32	6.1	120.5
	150mt	5.6	0.62	0.45	69.62	6.5	170.6
South	50mt	Road					
	100mt	5.5	0.61	0.41	64.31	5.8	154.3
	150mt	6.5	0.63	0.45	68.30	6.1	174.1

Table No. 02. The comparison of pH at different spot near brick kiln and half km away from brick kiln is represented in fig. 1.

Table 2- Physico-chemical parameter of soil half km away from Brick kiln

Season	pH	E.C. (dsm^{-1})	Organic carbon (%)	N (kg/Ha)	P (kg/Ha)	K (kg/Ha)
East	7.5	0.31	0.62	55.26	6.3	220.9
West	7.5	0.30	0.57	50.25	7.2	218.3
North	7.1	0.24	0.61	61.28	8.4	235.4
South	7.2	0.28	0.62	59.65	8.3	225.6

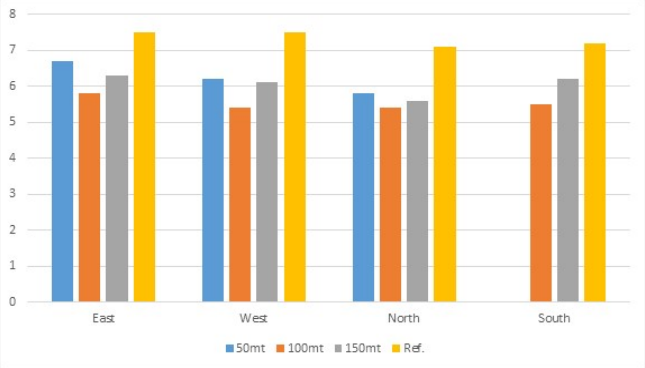

Fig. 1- Comparison of pH at different site near brick kiln and half km away from brick kiln.

CONCLUSION

The physico-chemical parameter of soil is adversely affected by brick kiln emission. In the present study, a brick kiln near Mathahi village of Madhepura district and physico-chemical parameter of soil at a distance of 50mt, 100mt and 150mt were examined. It was compared with physico-chemical parameter of soil half km away from brick kiln. It was observed that the pH near brick kiln decreased and Electrical conductivity became double. All essential nutrients like Nitrogen, Phosphorus and Potash also decreased near brick kiln. The pH was lowest (5.8) at 100mts away from brick kiln in its east side, pH 5.4 at North and west side and 5.5 in South side. Electrical conductivity became almost double at each spot, organic carbon was lower in comparison to the organic carbon in soil at half km away from the brick kiln. The lowest value of percentage organic carbon in soil was at 100mt away in east side (0.35). Nitrogen was also lower near all spots of brick kiln. The lowest value was observed in east side at 100mt away from brick kiln (42.35kg/Ha). Phosphorus was also lowest at this spot (4.3kg/Ha). The lowest value of Potash was observed at 100mt away from brick kiln in west side (100.6).

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