



Status of soil available nickel (Ni) in different districts of eastern Uttar Pradesh, India

SATISH KUMAR SINGH^{*1} and ABHIK PATRA²

Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221 005, India

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ABSTRACT

Limited information is available regarding status of available Ni in Indian soil and almost no literatures available on Ni deficient soils. Hence, the present investigation was undertaken to generate database on Ni content in soil and identifying the potential Ni deficit areas. Plant available Ni in different districts soils was assessed by analyzing 526 surface soil samples from Varanasi, 684 from Mirzapur, 523 from Sant Ravidas Nagar and 558 from Chandauli district. The soil samples were analysed for soil reaction (pH), EC, organic carbon and DTPA extractable Ni. All the blocks of Varanasi were high in Ni and its content ranged from 0.03–20.88 mg kg⁻¹. In Mirzapur district, overall 7.16% soil samples were Ni deficit, however at block level, highest deficiency was observed in Sikhar (31.67%) followed by Kon (27.78%) and Majhawa (24.32%). All the blocks of Sant Ravidas Nagar were high in nutrient index rating with variation in Ni content from 0.01–3.31 mg kg⁻¹. Among the four districts, lowest number of Ni deficient soils (1.79 %) were found in Chandauli district with high nutrient index rating. While Mirzapur district had highest Ni deficit soil (7.16%) followed by Sant Ravidas Nagar (4.02%), however, potential threat of Ni deficiency was the highest in Sant Ravidas Nagar (22%) followed by Mirzapur (19%).

Key words: Chandauli, Mirzapur, Nickel, Nutrient index, Sant Ravidas Nagar, Varanasi

Nickel is the 24th most abundant metal in the earth's crust and 5th most abundant element by weight after iron, oxygen, magnesium and silicon, constituting about 2% of the earth composition (Sunderman and Oskarson 1991). Total Ni concentration commonly ranged from 5 to 500 mg kg⁻¹, with an average of 50 mg kg⁻¹ in soil (Wilson and Benow 1978, Iyaka 2011). The response of Ni application to field crops (potato, wheat and beans) was first evident in 1945, but its essentiality was not conclusively demonstrated until 1987 (Brown *et al.* 1987). Eskew *et al.* (1983) reported that Ni-deficient soybean accumulates toxic levels of urea in its leaflet tips because of depression in urease activity in leaves. The discovery in 1975 that Ni is a component of the enzyme urease (Dixon *et al.* 1975), which is present in a wide range of plant species led to renewed scientific interest and research concerning the role of Ni in higher plants.

In most plant species, nickel deficiency is rarely observed because only very minute amounts of this metal are needed for normal metabolism, and the adequate range

between limiting and toxic concentrations is exceptionally large compared to other heavy metals (Gerendás *et al.* 1999). For this reason, it took a long time before Ni was identified as being essential for plant growth. Nickel has been termed an 'ultra-micronutrient' (Asher 1991) as its requirement is the lowest of all essential elements at < 0.5 mg kg⁻¹ of dry weight (Marchner 1995). Various soil factors such as texture, pH, electrical conductivity (EC), organic carbon, cation exchange capacity (CEC) and sesquioxides can influence the availability of Ni in soil (Bradl 2004, Mellis *et al.* 2004).

Limited information is available regarding status of Ni in Indian soil and almost no literatures available regarding work on identifying Ni status in the soils of India. Hence, the present investigation was undertaken to generate database with respect to Ni status in soil, which can be used as a guide for identifying the potential areas that may pose problems with respect to Ni deficiency in the years to come.

MATERIALS AND METHODS

Soil sampling sites detail

Varanasi district is situated in the middle Ganges valley of Eastern Uttar Pradesh and located at latitude 25°14' to 25°23' N and longitude 82°56' to 83°03' E with an altitude of 80.71 m. It covers an area of 1535 km² and comprised two tahsils and eight blocks with a total of 1327 villages. The Mirzapur district is located between the parallels of

*Corresponding author e-mail: sksingh_1965@rediffmail.com, ¹Professor (e-mail: sksingh_1965@rediffmail.com), ²Ph D student (e-mail: abhik.patra88@gmail.com), Department of Soil Science and Agricultural Chemistry, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India.

23°52'–25°32' N latitude and 82°07'–83°33' E longitude with an average elevation of 80 m. It covers an area of 4521 km² and comprised five tahsils and 12 blocks with a total of 1985 villages. As regards to district Sant Ravidas Nagar, it is situated in the planes of the river Ganges and located between the latitude of 25°12'–25°32' N and longitude 82°12'–82°42' E. It covers an area of 1015 km² and comprised three tahsils and five blocks with a total of 1224 villages. The Chandauli district is located between the 25°16'–25°27' N latitude and 83°16'–83°27' E longitude. It covers an area of 2541 km² and comprised three tahsils and nine blocks with a total of 1638 villages.

Collection of soil samples

The GPS based soil samples were collected from 10% randomly selected villages of each district. Thus, 89, 119, 88 and 93 villages were covered from Varanasi, Mirzapur, Sant Ravidas Nagar and Chandauli districts, respectively. In this endeavor, 526 surface soil samples from Varanasi, 684 from Mirzapur, 523 from Sant Ravidas Nagar and 558 from Chandauli district of Uttar Pradesh, India were collected for analyses.

Processing and analysis of soil samples

Soil samples were dried at room temperature and ground on wooden pestle and mortar and passed through 2 mm sieve. The soil samples were analyzed for soil reaction (pH) by preparing a soil: water suspension of 1:2.5 ratio (Sparks 1996). The soil-water suspension used for determination of pH was also used to estimate the electrical conductivity (EC) and expressed as dS m⁻¹ (Sparks 1996). Organic carbon (OC) content in the soil was determined by wet oxidation method as outlined by Walkley and Black (1934). Available Ni content in soil samples were extracted as per procedure given by Lindsay and Norvell (1978). The DTPA extractable Ni (available Ni) is considered as plant available Ni in soil.

Critical limit of Ni and nutrient indexing

The nutrient index value was calculated by using formula given by Parker *et al.* (1951) and the nutrient index rating was decided by using scores given by Ramamurthy and Bajaj (1969). If the value was <1.67, it falls under low nutrient index, between 1.67–2.33, it comes under medium and if the value is >2.33, it comes under high nutrient index.

$$\text{Nutrients index} = \frac{[(\text{PL} \times 1) + (\text{PM} \times 2) + (\text{PH} \times 3)]}{100}$$

where, PL, PM and PH are the percentage of soil samples falling in the category of low, medium and high nutrient status and giving weightage of 1, 2 and 3, respectively.

Categorization of available Ni in deficient, moderate and sufficient category was done on the basis of 0.22 mg kg⁻¹ DTPA extractable Ni as critical limit (Kumar *et al.* 2018). Thus, <0.22 mg kg⁻¹ DTPA extractable Ni content in soil was categorized as deficient, 0.22 – 0.44 mg kg⁻¹ as moderate and >0.44 mg kg⁻¹ as sufficient. The potential Ni deficiency was calculated by a sum total of present soil

samples falling in Ni deficient and moderate category.

RESULTS AND DISCUSSION

Varanasi district

In Varanasi district, the pH of the surface soil ranged from 6.9–9.5 with overall mean of 8.1 (Table 1). The soil samples of all eight blocks were alkaline in reaction except one soil sample of Chiraigaon block (pH 6.9). The electrical conductivity of the soil ranged from 0.02–0.33 dS m⁻¹ with a mean of 0.10 dS m⁻¹ and soil was non-saline. All the blocks were low in organic carbon content with an overall mean of 4.1 g kg⁻¹ and ranges from 0.6–9.0 g kg⁻¹. The DTPA extractable Ni content of Varanasi district (Table 1) ranged from 0.03–20.88 mg kg⁻¹ with an average of 1.87 mg kg⁻¹. Results revealed that the Varanasi district fall under high Ni status with only 3.42% Ni deficient soil samples. All the blocks were high in Ni status however, highest Ni deficient soil was in Baragaon block (10.26%) followed by Harahua block (7.69%). From the Pearson's correlation analysis, it was revealed that soil pH had significant negative correlation with available Ni content in the soils of Araziline (-0.34**) and Sevapuri (-0.30*) block and OC had significant negative correlation with Ni content in Chiraigaon blocks (-0.28*).

Mirzapur district

The pH of the surface soils of Mirzapur district ranged from 5.0–9.9 with a mean of 7.5 and the soil was acidic to alkaline in pH (Table 2). The electrical conductivity ranged from 0.01–0.50 dS m⁻¹ with a mean of 0.09 dS m⁻¹. Overall organic carbon status of the soils of this district ranged from 1.10–15.3 g kg⁻¹ with a mean value of 5.40 g kg⁻¹ and most of the blocks were medium in OC content except Sikhar (3.2 g kg⁻¹). Among all the districts, Mirzapur had the maximum (7.16%) Ni deficiency in soil. Three blocks of Mirzapur fall under medium Ni status, *i.e.* Sikhar, Kon and Majhawa where respective deficiency in soil samples was 31.7, 27.8 and 24.3%. Overall nutrient index of Mirzapur was high with respect to available Ni. Available Ni content ranged from 0.01–8.71 mg kg⁻¹ with a mean of 1.30 mg kg⁻¹. The lowest available Ni was noted in Kon block followed by Majhawa and Sikhar block with an average Ni content of 0.41, 0.47 and 0.48 mg kg⁻¹, respectively. In Mirzapur district, Pearson's correlation analysis revealed that soil pH had significant negative correlation with plant available Ni (-0.12*). Soil OC significantly and negatively correlated with available Ni content in the Sikhar block (-0.68**).

Sant Ravidas Nagar district

The soil samples of Sant Ravidas Nagar were slightly acidic to alkaline in reaction and the pH ranged from 6.1–9.6 with a mean of 8.1 (Table 3). The electrical conductivity of the soil ranged from 0.01–2.12 dS m⁻¹ with a mean of 0.10 dS m⁻¹. The organic carbon content was found low in the soils of Sant Ravidas Nagar and ranged from 0.90–11.3 g kg⁻¹ with a mean value of 4.0 g kg⁻¹. The average available Ni content of this district was 0.99 mg kg⁻¹ and ranged

Table 1 Percentage of soil sample falling under different soil test categories with respect to DTPA extractable Ni in Varanasi district

Block	No. of samples	Soil properties		DTPA-extractable Ni (mg kg ⁻¹)	% sample category of available Ni			Nutrient Index	Rating	Deficiency (%)	Correlation with Ni			
		pH	EC (dS m ⁻¹)		OC (g kg ⁻¹)	D	M				S	pH	EC	OC
Kashi Vidyapeeth	42	7.2-8.8 (8.1) [#]	0.03-0.33 (0.13)	1.5-6.9 (4.1)	1.72-3.85 (2.58)	0	0	100	3	High	0	-0.11	0.05	-0.07
Araziline	108	7.1-8.6 (8.0)	0.03-0.3 (0.12)	0.6-7.7 (4.1)	0.13-4.42 (2.66)	1	0	99	2.98	High	0.93	-0.34**	0.33**	-0.02
Sevapuri	72	7.1-8.8 (8.1)	0.02-0.65 (0.09)	0.6-8.9 (4.4)	0.20-4.55 (1.36)	6	12	82	2.76	High	5.56	-0.30*	0.26*	-0.03
Harahua	52	7.5-9.2 (8.1)	0.03-0.97 (0.10)	0.9-7.1 (4.1)	0.06-1.91 (0.58)	8	31	61	2.54	High	7.69	-0.25	-0.04	-0.24
Chiragaon	54	6.9-8.7 (8.1)	0.02-0.25 (0.07)	1.1-9.0 (4.2)	0.22-1.99 (1.19)	2	0	98	2.96	High	1.85	0.05	0.42**	-0.28*
Baragaon	78	7.1-9.4 (8.2)	0.03-0.36 (0.09)	1.5-9.0 (4.5)	0.03-20.88 (3.22)	10	9	81	2.71	High	10.26	0.01	-0.13	-0.11
Pindra	60	7.3-9.5 (8.2)	0.03-0.51(0.09)	0.9-6.8 (3.6)	0.40-3.56 (1.56)	0	2	98	2.98	High	0	-0.12	0.04	-0.18
Cholapur	60	7.2-9.3 (8.2)	0.04-0.60 (0.10)	0.8-6.9 (3.6)	0.39-2.33 (1.08)	0	3	97	2.97	High	0	-0.15	-0.23	0.23
Overall	526	6.9-9.5 (8.1)	0.02-0.33 (0.10)	0.6-9.0 (4.1)	0.03-20.88 (1.87)	3	7	90	2.87	High	3.42	0.01	0.15**	-0.09

D = Deficient, M = moderate, S = sufficient; [#]Data in parentheses showed the mean value; *significant at p<0.05 level, **significant at p<0.01 level

Table 2 Percentage of soil sample falling under different soil test categories with respect to DTPA extractable Ni in Mirzapur district

Block	No. of samples	Soil properties		DTPA-extractable Ni (mg kg ⁻¹)	% sample category of available Ni			Nutrient Index	Rating	Deficiency (%)	Correlation with Ni		
		pH	EC (dS m ⁻¹)		D	M	S				pH	EC	OC
Sikhar	60	7.0-8.4 (7.8) [#]	0.01-0.48 (0.18)	1.4-6.2 (3.2)	32	26	42	2.10	Medium	31.67	0.25*	0.14	-0.68**
Narayanpur	72	6.7-9.6 (8.0)	0.02-0.26 (0.11)	1.1-11.3 (6.3)	1	8	91	2.89	High	1.39	-0.47**	-0.40**	-0.21
Jamulpur	96	6.1-9.9 (7.4)	0.03-0.13 (0.08)	1.4-13.2 (6.3)	4	5	91	2.86	High	4.17	-0.11	0.05	-0.10
Kon	18	7.2-8.7 (8.3)	0.03-0.13 (0.05)	3.5-10.2 (5.4)	28	33	39	2.11	Medium	27.78	-0.01	-0.02	0.23
Majhawa	37	6.7-8.6 (7.8)	0.02-0.32 (0.08)	2.0-9.9 (5.3)	24	24	52	2.27	Medium	24.32	0.59**	-0.10	0.01
Nagar city	66	6.7-8.7 (8.0)	0.01-0.40 (0.09)	1.1-8.9 (5.0)	6	15	79	2.73	High	6.06	0.16	-0.03	0.01
Rajgarh	54	5.2-8.1 (6.6)	0.01-0.19 (0.05)	2.7-15.3 (6.6)	7	8	85	2.78	High	7.41	-0.34*	-0.01	0.22
Chhionway	56	6.7-8.7 (8.0)	0.02-0.50 (0.07)	3.2-11.1 (5.6)	0	12	88	2.88	High	0	0.31*	0.35*	0.19
Marthan	34	5.5-8.2 (7.1)	0.01-0.36 (0.07)	2.4-9.8 (6.6)	9	23	68	2.59	High	8.82	-0.46**	-0.25	-0.24
Lalganj	66	5.4-9.2 (7.6)	0.01-0.45 (0.09)	1.2-10.5 (6.3)	0	5	95	2.95	High	0	-0.31*	0.31*	-0.07
Halia	96	5.0-8.8 (6.9)	0.01- 0.49 (0.10)	1.5-9.8 (4.8)	0	0	100	3	High	0	-0.22*	0.04	0.12
Pahari	29	6.9-8.4 (7.6)	0.02-0.19 (0.06)	1.5-8.6 (4.6)	0	17	83	2.83	High	0	0.21	0.12	0.08
Overall	684	5.0-9.9 (7.5)	0.01-0.50 (0.09)	1.1-15.3 (5.4)	7	12	81	2.74	High	7.16	-0.12*	0.10*	-0.02

D = Deficient, M = moderate, S = sufficient; [#]Data in parentheses showed the mean value; *significant at p<0.05 level, **significant at p<0.01 level

Table 3 Percentage of soil sample falling under different soil test categories with respect to DTPA extractable Ni in Sant Ravidas Nagar district

Block	No. of samples	Soil properties			DTPA-extractable Ni (mg kg ⁻¹)	% sample category of available Ni			Nutrient Index	Rating	Deficiency (%)	Correlation with Ni		
		pH	EC (dS m ⁻¹)	OC (g kg ⁻¹)		D	M	S				pH	EC	OC
Bhadohi	91	7.7-9.6 (8.5) [#]	0.02-2.12 (0.19)	1.5-9.5 (3.8)	0.01-3.31 (1.17)	12	15	73	2.60	High	12.09	0.16	0.03	0.21*
Suriyawan	90	7.0-9.6 (8.3)	0.01-0.70 (0.08)	1.4-8.9 (3.6)	0.37-2.19 (1.34)	0	2	98	2.98	High	0	-0.23*	-0.27**	-0.20*
Digh	66	6.1-8.7 (7.7)	0.01-0.47 (0.05)	0.9-6.5 (2.7)	0.10-1.31 (0.57)	5	36	59	2.55	High	4.55	-0.08	0.15	0.11
Aurai	144	6.1-8.9 (7.8)	0.02-0.44 (0.08)	1.1-11.3 (5.2)	0.17-2.23 (1.04)	3	12	85	2.83	High	2.78	-0.12	-0.09	-0.02
Gyanpur	132	6.3-9.6 (8.0)	0.02-0.21 (0.07)	0.8-9.2 (3.8)	0.08-2.28 (0.79)	2	27	71	2.68	High	2.27	-0.26**	0.06	-0.06
Overall	523	6.1-9.6 (8.1)	0.01-2.12 (0.10)	0.9-11.3 (4.0)	0.01-3.31 (0.99)	4	18	78	2.74	High	4.02	0.04	0.08	0.16**

D = Deficient, M = moderate, S = sufficient; [#]Data in parentheses showed the mean value; *significant at p<0.05 level, **significant at p<0.01 level

0.01–3.31 mg kg⁻¹. Bhadohi had 12.09% Ni deficient soils and it was the highest among the blocks of Sant Ravidas Nagar district. All the blocks of this district falls in high Ni status and overall 4.02% soil samples were deficit. From the Pearson's correlation analysis, it was revealed that soil pH had significant negative correlation with DTPA extractable Ni content in the blocks of Suriyawan (-0.23*) and Gyanpur (-0.26*). Plant available Ni had significant positive correlation with soil OC content in Bhadohi block (0.21*) and significant negative correlation in Suriyawan block (-0.20*).

Chandauli district

The pH of the surface soils of Chandauli district ranged from 4.5–9.4 with a mean of 7.2 (Table 4) and the soil samples had a wide variation in pH from acidic to alkaline. The electrical conductivity ranged from 0.01–0.73 dS m⁻¹ with a mean of 0.10 dS m⁻¹. The organic carbon content in soils of this district ranged from 0.8–11.7 g kg⁻¹ with a mean of 4.7 g kg⁻¹. Among all the districts, Chandauli had the lowest Ni deficit soil (1.79%). All the blocks of this district were high in Ni rating and Niyamtabad block had the maximum Ni deficient soil samples (6.67%). In Chandauli district, available Ni content ranged from 0.01–3.73 mg kg⁻¹ with a mean value of 0.94 mg kg⁻¹. Pearson's correlation analysis revealed that Chandauli district had a significant negative correlation between soil pH and available Ni content (-0.59**). Barahani and Chandauli block also showed a significant negative correlation between DTPA extractable Ni and organic and overall at district level this correlation was also significantly negative (-0.30**).

Potential threat of Ni deficiency

From the present investigation, it was observed that 3, 7, 4 and 2% soil samples (Fig 1) were deficient in plant available Ni in the respective, districts of Varanasi, Mirzapur, Sant Ravidas Nagar and Chandauli. But, the potential threat of Ni deficiency was far high than the actual deficiency which is the sum total of Ni deficient and moderate soil samples. In Varanasi district (Fig 1), 10% soil samples fall under potential Ni deficient group. As regards to the potential treat of Ni deficiency at block level, the highest was in Harahua (39%) followed by Baragaon (19%) and Sevapuri (18%). Likewise in Mirzapur district, 19% soils were potentially Ni deficient. However, the Kon block had 61% potential Ni deficiency in soil followed by 58% in Sikhar and 48% in Majhawa. As regards to the potential Ni deficiency in Sant Ravidas Nagar, it was 22%. Although, the highest potential threat of soils to be Ni deficient in future were 41% in Digh followed by 29% in Gyanpur and 27% in Bhadohi block. Similarly, 16% soils were potentially Ni deficient in Chandauli district, but at block level, the highest potential threat was in Chahniya block (55%) followed by Niyamtabad (35%).

Correlation

Pearson's correlation analysis revealed that soil pH had

Table 4 Percentage of soil sample falling under different soil test categories with respect to DTPA extractable Ni in Chandauli district

Block	No. of samples	Soil properties			DTPA-extractable Ni (mg kg ⁻¹)		% sample category of available Ni			Nutrient Index	Rating	Deficiency (%)	Correlation with Ni		
		pH	EC (dS m ⁻¹)	OC (g kg ⁻¹)			D	M	S				pH	EC	OC
Niyamtabad	60	7.5-9.3 (8.4) [#]	0.04-0.67 (0.16)	1.4-11.7 (4.8)	0.03-1.01 (0.53)		7	28	65	2.58	High	6.67	-0.08	0.25*	0.10
Chandauli	66	5.0-8.4 (7.0)	0.02-0.32 (0.07)	0.8-8.1 (4.1)	0.31-2.93 (1.44)		0	2	98	2.98	High	0	-0.56**	0.10	-0.30*
Barahani	66	5.4-8.5 (7.3)	0.02-0.04 (0.09)	2.0-8.0 (5.3)	0.16-1.71 (0.74)		1	14	85	2.83	High	1.52	-0.45**	0.04	-0.50**
Chahniya	66	7.0-9.4 (8.1)	0.02-0.73 (0.17)	2.1-9.5 (4.8)	0.16-1.18 (0.48)		5	50	45	2.41	High	4.55	-0.24	0.20	-0.20
Dhanapur	48	6.0-9.1 (7.5)	0.02-0.20 (0.07)	2.0-11.0 (4.8)	0.01-1.82 (0.72)		5	16	79	2.75	High	4.17	-0.18	0.14	-0.01
Nawgarh	36	5.0-7.8 (5.8)	0.02-0.33 (0.05)	1.4-8.6 (5.6)	0.45-2.09 (1.27)		0	3	97	2.97	High	0	-0.46**	0.27	-0.22
Sakaldiha	66	6.1-9.1 (7.7)	0.03-0.52 (0.12)	0.8-2.3 (4.4)	0.36-1.34 (0.78)		0	8	92	2.92	High	0	-0.67**	0.12	-0.20
Sahabganj	66	4.5-8.7 (6.4)	0.01-0.28 (0.08)	0.9-8.4 (5.0)	0.50-2.42 (1.25)		0	0	100	3	High	0	-0.37**	0.08	-0.23
Chakia	84	5.3-8.7 (6.3)	0.02-0.34 (0.07)	0.9-9.6 (4.4)	0.39-3.73 (1.24)		0	5	96	2.96	High	0	-0.25*	0.08	0.04
Overall	558	4.5-9.4 (7.2)	0.01-0.73 (0.10)	0.8-11.7 (4.7)	0.01-3.73 (0.94)		2	14	84	2.83	High	1.79	-0.59**	0.04	-0.3**

D = Deficient, M = moderate, S = sufficient; [#]Data in parentheses showed the mean value; *significant at p<0.05 level, **significant at p<0.01 level

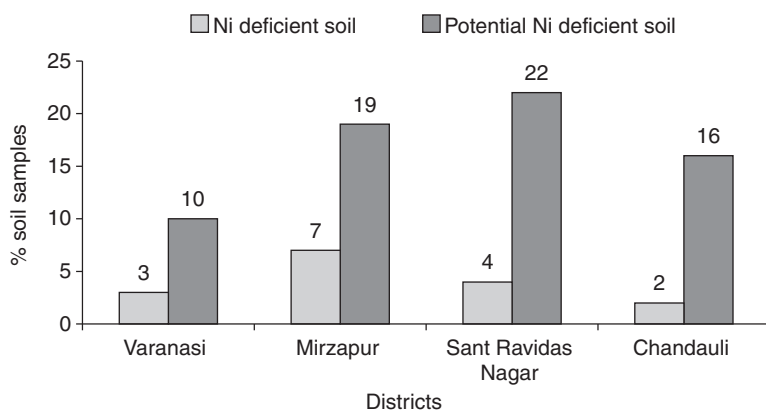


Fig 1 Scenario of Ni deficiency soils in Varanasi, Mirzapur, Sant Ravidas Nagar and Chandauli districts of Uttar Pradesh.

significant negative correlation with DTPA extractable Ni content in various blocks of the study areas. The probable reasons may be that the mobility of Ni in soil solution was inversely related to the soil pH (Richter and Theis 1980) because low pH creates reduced condition which increases the Ni^{2+} activity in soil (Ponizovsky *et al.* 2008). There is a two-fold explanation for decrease in Ni availability with increasing pH: (a) as pH increases, metal hydrolysis increases, and this in turn enhances Ni sorption and (b) as pH increases, the electronegative charge onto the surfaces of variable-charge colloids (including organic matter, Al and Fe oxides, 1:1 clay minerals, and particle edges of 2:1 clay minerals) also increases; thus soil retention capacity increases for Ni (Wang *et al.* 2015, Wang *et al.* 2016).

Pearson's correlation analysis between soil OC and plant available Ni in this study, revealed that most of the blocks had significant negative correlation with plant available Ni content in soil. The result was in line with the findings of Katyal and Sharma (1991) and Almås *et al.* (2000) who found decreased availability of metal with application of organic amendments due to slow release of metals from organic-metal complex. Further, decrease in Ni availability with increasing OC may be attributed to: (a) organic matter adds CEC to soil, increasing thus the overall soil retention capacity for Ni (Tejada *et al.* 2008, Kabata-Pendias 2010) and (b) organic matter readily creates ligands with elements of sufficiently high molecular weight that roots are unable to absorb or are insoluble in soil solution and ultimately decreased Ni availability to plants (Elfoughi *et al.* 2012, Shaheen *et al.* 2017).

From the present study, it can be concluded that Mirzapur district was most prone to Ni deficiency (7%) and among the blocks of this district Sikhar had highest (31.67%) deficiency followed by Kon (27.78%) and Majhawa (24.32%). The potential threat of Ni deficiency was highest in Sant Ravidas Nagar (22%) though it had only 4% Ni deficit soil, followed by Mirzapur (19%). To my knowledge, this is the first paper depicting the deficiency of Ni in Indian soil. Potential threat of Ni deficiency brought out in this study will be useful in managing the Ni deficiency problem in soils in the years to come.

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