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Research Article

EVALUATION OF SOIL FERTILITY STATUS OF NAGRA BLOCK OF BALLIA DISTRICT OF UTTAR PRADESH

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Abstract: 30 village of Nagra block of Ballia district composite surface soil samples were collected for the study of physico-chemical and chemical properties of soil for nutrients index by used of standard procedure. Soil pH was slightly alkaline, E.C. in medium range and favourable, bulk density ranged from 1.27-1.54 Mgm^{-3}, water holding capacity 40.60-46.93%, organic carbon from 0.33-0.98 % respectively. Soils of targeted villages were moderately calcareous (1.05-1.62% $CaCO_3$), available N, P, K and S content in soil varied from 244.60-370.04 $kgha^{-1}$, 9.01-15.23 $kgha^{-1}$, 193.31-323.90 $kgha^{-1}$ and 7.0-19.0 mgkg-1 range, respectively. The nutrient index value of available nitrogen 1.96, available phosphorus 1.1 and available potassium 2.3, respectively.

Keywords: *Soil organic Carbon, Available N, P, K, S, Nutrient index value*

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Introduction

Available nutrient in soils play pivotal role in determination of fertility status and sustainable productivity of soils. Hence, soil test based fertilizer recommendation could be an effective tool for optimizing soil fertility and productivity. The available nitrogen (N) content of the Ballia district in Uttar Pradesh ranged from 37 to 275 kg ha^{-1} with a mean value of 128 kg ha^{-1}, phosphorus (P) content ranged from 2 to 332 kg ha^{-1} with a mean of 31 kg ha^{-1} while that of potassium (K) content ranged from 55 to 996 kg ha^{-1} with an overall mean value of 250 kg ha^{-1} [1], Calcium (Ca), magnesium (Mg) and sulphur (S) are termed as secondary essential plant nutrients because of their moderate requirements by growing plants [2]. Most of the soils of the Indo-Gangetic of plains of alluvial soils are prone to S deficiency and widespread S deficiency has been reported in alluvial soils of Varanasi district and Ballia district [3,4]. The low-lying areas of Vindhyan soils of have higher fertility level than that of upland areas with terrace containing sandstone and limestone shale [5]. According to the report by Singh *et al.* (2015), low organic carbon (OC) content was observed in some Vindhyan upland soils of Mirzapur district in eastern Uttar Pradesh with slight to moderately acidic in nature. In view of the paucity of information on soil fertility status of physical and chemical parameters of the study area was undertaken to study the status of available nutrients in vegetables, oilseeds and pulses growing area of Indo-Gangetic-Ghaghara alluvial soils of Nagra block of Ballia district in eastern Uttar Pradesh. An attempt was also made to correlate soil available nutrients content with other relevant properties of soils.

Materials and methods

Ballia district is the eastern part of Uttar Pradesh situated in central portion of the Ganges basin. The geographical extent of the district lies between latitude from 25°23" to 26°11" north and at longitudes from 83°38" to 84°39" east with elevation of about 57-64 meters above the sea level. The mean annual rainfall ranges from 950 to 1150 mm. The area truly represents the agronomical conditions of north east alluvial plains. A 30 composite surface soil samples were collected from 30 villages of Nagra block from different cropped areas. Soil samples were air dried in shade and powdered gently with a wooden mallet and passed through 2 mm sieve.

Soil pH was determined in 1:2.5 soil-water suspension using glass electrode. Electrical conductivity (E.C.) was determined in 1:2.5 soil-water extract using Electrical Conductivity meter (dSm^{-1}) [6]. Calcium carbonate ($CaCO_3$) was determined by rapid titration method [7]. Bulk density method described by Kanwar and Chopra, (1998) [8]. Organic carbon (O.C.) was determined by rapid titration method of Walkley and Black, (1934) [9]. Available nitrogen (N) was determined by alkali extractable nitrogen method [10], available phosphorus (P) by Olsen *et al*., (1954) and available potassium (K) through a flame photometer after extraction with ammonium acetate extractable method of Muhr *et al*., (1965). Available sulphur (S) was extracted using 0.15 percent calcium chloride solution [11]. The nutrient index was calculated by using the equation as proposed by Parker *et al*. (1951). In this method, the number of samples in each of the three categories, low (<1.67), medium (1.67-2.33) and high (2.33) as obtained from the analysis was multiplied by 1, 2 and 3, respectively. The total of the figures thus obtained was divided by total number of samples.

Nutrient index Value (NIV) = (L ×1) + (M × 2) + (H × 3) / No. of samples (L+M+H)

Where, L, M and H are the number of soil samples falling in category of low, medium and high nutrient status.

Results and discussion

Soil pH

The pH range from 8.86 to 6.70 from soil samples of different village [Table-1]. The highest pH value 8.86 was in soil of Parshurampur village as compared to lowest pH value 6.70 in Baraich village soil. The average pH value of Nagra block was 7.8 but their range was mostly toward alkalinity due to presence of alkaline salts and present material resulted in higher P adsorption. The higher biological activities might be responsible for decrease pH range on surface soil. The pH value showed in variation of different village which has attributed to the dominance of pH value from location to another was due to both season crop raising and farmers using imbalance chemical fertilizers, pesticides and cultural practices.

Soil E.C. (dSm^{-1})

The soil E.C. from different village surface soil samples range from 0.48 to 1.52 dSm^{-1}.

The maximum E.C. value 1.52 dSm^{-1} in soil sample of Nagra village as compared to lower E.C. value 0.48 dSm^{-1} in Lahsani village. The average value of E.C. of Nagra block soil was 0.83 dSm^{-1}. Which might be ascribed to the lateral movement of water from the construction of earthen bund on ground [12]. It was varied between 0.55 to 1.52 dSm^{-1} characteristic of the normal alluvial soil with not much more differences.

Bulk density (Mgm^{-3})

All village surface soil sample of Nagra block were range from 1.54 Mgm^{-3} to 1.27 Mgm^{-3} but the highest value of bulk density 1.54 Mgm^{-3} was observed in soil samples of Gaura village and lowest value 1.27 Mgm^{-3} was in soil of Kasoundar, Nagra and Mahri village [Table-1]. Average value of bulk density of Nagra block soil was 1.40 Mgm^{-3} might be due to mixture of soil along with organic substances. The greater bulk density values have indicator of increased mineral content in soil.

Water Holding Capacity (%)

It has range from 46.93 to 40.60 % in all soil samples of villages of Nagra block [Table-1]. The highest water holding capacity value observed in Baraich village of 46.93 % and the lowest value observed in Dilman madukipur village of 40.60 %. The average value of water holding capacity of Nagra block soil was 43.26 % might be due to physical and chemical composition as well as organic constituent of soil.

Table-1 Physical and chemical properties of surface soil of different village of Nagra block of Ballia district

SN	Village name	pH	E.C. (dSm^{-1})	Bulk density (Mgm^{-3})	W.H.C (%)	Organic carbon (%)
1	Kaisaili kasesar	7.94	0.62	1.37	42.59	0.88
2	Kasoundar	8.36	0.81	1.27	42.51	0.77
3	Abdulpur Madari	7.86	0.65	1.49	42.38	0.90
4	Barewa	7.80	0.50	1.32	42.61	0.67
5	Barwa ratti patti	8.20	0.85	1.43	42.66	0.90
6	Rupwar Bhagwanpur	8.00	0.54	1.34	42.56	0.96
7	Sikariya	7.86	0.56	1.49	42.51	0.92
8	Gaura	8.48	1.04	1.54	42.34	0.48
9	Khandwa	8.28	0.86	1.51	42.49	0.93
10	Masuriya	7.42	0.92	1.41	42.40	0.92
11	Vishnupura	6.83	0.84	1.31	42.56	0.74
12	Taribada gaon	7.92	1.08	1.39	42.73	0.98
13	Bisruf	7.09	1.07	1.32	46.19	0.93
14	Chachiya	8.46	0.85	1.40	42.61	0.98
15	Dilman madukipur	8.26	0.65	1.52	40.6	0.71
16	Develveer	7.70	1.04	1.51	46.73	0.56
17	Lahsani	7.04	0.48	1.41	40.84	0.98
18	Pal chandraha	7.76	0.85	1.39	42.39	0.88
19	Parshurampur	8.86	0.88	1.38	43.23	0.68
20	Parsia ruppur	6.94	0.68	1.39	44.53	0.48
21	Sawapar	7.08	1.28	1.52	41.91	0.49
22	Sikandrapur	8.20	0.64	1.30	41.73	0.68
23	Barooli	7.60	0.86	1.33	43.07	0.89
24	Tirnaimoula Rai	8.35	0.80	1.43	41.65	0.58
25	Trilok manda	8.48	1.05	1.36	44.63	0.90
26	Nagra	7.60	1.52	1.27	45.81	0.71
27	Mahri	7.10	0.48	1.27	44.33	0.92
28	Maharajpur	8.15	1.04	1.53	44.39	0.37
29	Baraich	6.70	0.55	1.43	46.93	0.33
30	Bhimpura Number 1	7.74	0.86	1.34	45.94	0.68
	Average value	7.80	0.83	1.40	43.26	0.79

Organic carbon (%)

Surface soil of different village of Nagra block was range from 0.33 to o.98 % organic carbon The lowest organic carbon value 0.33 % was observed in Baraich soil and highest organic carbon value 0.98 % observed in soils of Taribada gaon, Lahsani and Chachiya villages respectively. The average value of organic carbon content in Nagra block soil was range from 0.33 % to 0.98 % might be due to small oxidation of organic matter in surface soil of 30 village of Nagra block was medium in all surface (0-15 cm) due to greater organic material accumulation was observed [13], difference in organic carbon content of the soil and high rate of possible CO_2 evolution leads to low organic carbon [14].

Calcium carbonate (%)

Calcium carbonate value ranged from 1.62 % to 1.05 % in surface soil sample of different village [Table-2]. The highest value 1.62 was observed in Nagra village and lowest calcium carbonate value was observed in Rupwar bhagwanpur, Bisruf and Tari bada gaon villages were 1.05 %. The average value of calcium carbonate from all samples were 1.30 % of greater content of $CaCO_3$ might be due to carbonation with calcium.

Available nitrogen (kg/ha)

The available nitrogen content in surface soil from different village were ranged from 370.04 to 244.60 $kgha^{-1}$[Table-2]. The highest value 370.04 kg/ha were observed in Dilman madukipur, Sikariya and Pal chandraha while lowest value 244.60 kg/ha was observed in Kasoundar village. The average value of all village sample was 332.83 kg/ha it might be due to mineralization of organic matter to release of sufficient amount of available nitrogen.

Available phosphorus (kg/ha)

Surface soil from different village for available phosphorus were ranged from 5.01 to 15.23 $kgha^{-1}$ showed considerable amount of available phosphorus but highest available phosphorus value 15.23 kg/ha was observed in Kaisaili kasesar village as compared to lowest value 5.01 kg/ha in Rupwar bhagwanpur village [Table-2]. While average value in all villages of Nagra block samples were 8.06 kg/ha that have medium and low range of available phosphorus might be due to greater $CaCO_3$ content might be minimize the available phosphorus, fixation process has also responsible for low content in the area [15].

Available potassium (kg/ha)

Available potassium was ranged from 323.90 kg/ha to 193.31 kg/ha in the surface soil samples of different village of Nagra block [Table-2]. The maximum value 323.90 kg/ha was observed in Barewa rattipatti village while lowest content 193.31 kg/ha was found in Taribada gaon. The average quantity 259.95 kg/ha was found in soil samples of different village of Nagra block. The higher and medium range of NH_4OAc extractable potassium in all villages surface soil of Nagra block have appeared might be due to parent materials as dominating clay minerals in the surface soil.

Available sulphur (mg/kg)

Available sulphur value range from 7.0 to 19.0 $mgkg^{-1}$ in different village of Nagra block soil but the highest available sulphur value 19.00 mg/kg(Medium range) was observed in Kaisaili Kasesar and smallest value 7.00 mg/kg (minimum range) was observed in Lahsani and Tirnaimoula rai village [Table-2]. The average value of Nagra block soil samples were 11.87 mg/kg, that medium and low range of available sulphur content in different village of Nagra block soil might be due to natural and organic sources and their slow activities.

Nutrient index

Nutrient index value for different nutrients in soil samples of different village of Nagra block appeared as low, medium and high [Table-3]. The NI ratings of <1.5, 1.5 2.5 and >2.5 to represent low, medium and high fertility of soils of the given area, respectively. The nutrient index of available nitrogen was 1.966 or 1.97 falls in medium fertility level. The nutrient index of available phosphorus was 1.1 falls in low fertility level and the nutrient index available potassium was 2.3 falls in medium fertility level. It seems to the 29 samples in medium and 01 sample falls in low range for available nitrogen, 03 samples in medium and 27 samples were falls in lower range for available phosphorus, 21 samples in medium and 09 samples falls in higher range for available potassium while 24 samples in medium and 06 samples falls in lower range for available sulphur out of 30 composite soil samples of 30.

Conclusion

The pH and E.C. value of soil was medium level shows the slight alkaline to high saline nature low content soluble salts. Bulk density of villages was in considerable amount and the average value of W.H.C is in considerable range of overall soil of villages. Organic carbon of soils was medium to higher range shows measurable component of soil organic matter. The average value of $CaCO_3$ in soils of these villages are considerable range for crop production.

Table-2 Chemical properties of surface soil of different village of Nagra block of Ballia district

SN	Village name	$CaCO_3$ (%)	Available Nitrogen (kg/ha)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)	Available Sulphur (mg/kg)
1	Kaisaili kasesar	1.25	307.32	15.23	210.00	19.00
2	Kasoundar	1.15	244.60	11.91	257.60	11.50
3	Abdulpur madari	1.38	338.68	7.70	240.80	12.75
4	Barewa	1.50	319.87	6.72	230.90	12.00
5	Barwa ratti patti	1.55	332.41	5.82	323.90	16.50
6	Rupwar bhagwanpur	1.05	326.14	5.01	321.92	11.5
7	Sikariya	1.20	370.04	7.34	291.42	11.75
8	Gaura	1.30	338.68	7.88	269.16	11.00
9	Khandwa	1.25	319.87	8.60	258.27	12.00
10	Masuriya	1.55	326.14	7.34	235.26	10.75
11	Vishnupura	1.12	307.32	6.72	212.35	12.25
12	Tari bada gaon	1.05	338.68	5.82	193.31	11.50
13	Bisruf	1.05	326.14	7.97	245.95	10.25
14	Chachiya	1.30	351.23	8.24	274.40	15.50
15	Dilman madukipur	1.15	370.04	8.78	316.51	8.25
16	Develveer	1.25	363.77	7.97	271.71	13.25
17	Lahsani	1.43	357.50	7.34	260.51	7.00
18	Pal chandraha	1.55	370.04	7.70	210.00	16.75
19	Parshurampur	1.25	338.68	8.24	213.02	11.12
20	Parsia ruppur	1.20	319.87	6.72	321.92	15.50
21	Sawapar	1.30	351.23	6.09	291.87	16.75
22	Sikandrapur	1.15	301.05	6.80	280.67	11.00
23	Barooli	1.30	307.32	7.97	313.82	12.00
24	Tirnaimoula rai	1.55	338.68	9.13	235.42	7.00
25	Trilok manda	1.38	319.87	8.24	257.47	10.75
26	Nagra	1.62	326.14	12.36	267.47	9.00
27	Mahri	1.15	357.50	8.60	236.09	8.50
28	Maharajpur	1.40	326.14	7.70	218.17	9.00
29	Baraich	1.50	338.68	7.61	258.04	11.12
30	Bhimpura number 1	1.07	351.23	8.24	280.67	10.75
	Average value	1.30	332.83	8.06	259.95	11.87

Table-3 Nutrient index of surface soil of different village of Nagra block of Ballia district

Soil available nutrients	Soil samples falling in each category of fertility level			Nutrient index value	Rating
	Low	Medium	High		
Available N	1	29	0	1.96	Medium
Available P	27	3	0	1.1	Low
Available K	0	21	9	2.3	Medium
Available S	6	24	0	1.8	Medium

The average value of available nitrogen in soils were medium level shows the medium range, available phosphorus in low level show low content, available potassium in village soils were medium, available sulphur in medium level. Soils of all villages appeared in medium and low nature of available nutrient content.

Application of research: This research woks will be helpful to provide the information regarding the status of soil fertility for crop production and suitability. It will helpful to policy planning for nutrient as well as fertilizers requirement of targeted area.

Research Category: Soil Fertility and Soil Chemistry

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Study area / Sample Collection: Ballia District of Uttar Pradesh

Cultivar / Variety / Breed name: Nil
Conflict of Interest: None declared

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