Short Communication *Agropedology 2010, 20 (1), 85-87*

Nutrient availability in soils as affected by physiography in Chittorgarh district, Rajasthan

H. B. MEENA, J. D. GIRI[1] AND H. K. MISHRA

Department of Agricultural Chemistry and Soil Science,
Maharana Pratap University of Agriculture and Technology, Udaipur-313 001, India
[1]National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur- 440 010, India

Variation in soil properties from place to place arise from differences in parent material, climate, topography, biosphere and the age of ground surface. Even if the parent material does not vary, the variation in physiography in a given area significantly affects the soil properties and, in turn, nutrient availability. The information regarding effect of physiography on nutrient availability is limited except that reported in Gagghar flood plain of Haryana (Singh and Ahuja 1990) and Rajasthan (Shyampura *et al.* 1992). Therefore, an investigation was carried out to study the landform-nutrient availability relationship in Chittorgarh district, Rajasthan.

Chittorgarh district in Rajasthan is situated between 23° 12' to 25° 13' N and 74° 12' to 75° 49' E and covers an area of 1108.58 sq km. The district is characterized by semi-arid monsoonic climate with mean annual precipitation of 1008 mm with 34 rainy days. The moisture and temperature regimes are 'ustic' and 'hyperthermic', respectively.

Fifteen pedons were exposed on three different physiography viz. Eastern Rajasthan Upland (ERU), Pathar and Bundelkhand Plateau (PB) and Malwa Plateau (MP). In each physiography, five pedons were studied for site and morphological properties. Horizon-wise soil samples were analysed for available nutrients like N, P, K, Zn, Cu, Fe and Mn using standard laboratory methods (Jackson 1972; Page 1986) and soils were classified as per Soil Survey Staff (2003).

The site, morphological and soil properties (bulk density, AWC, pH, EC, CaCO3, organic carbon, exch. cations and CEC have been reported elsewhere (Meena *et al.* 2009). Available nitrogen was the highest in soils of ERU followed by that in PB and MP (Table 1) and it might be partly due to management practices also. The available nitrogen was higher in the surface and decreased with depth. This could be attributed to organic carbon which has a high correlation with available nitrogen. Similar observations have been made by many researchers (Sharma, *et al.* 1968; Rajkumar *et al.* 1995; Sharma, 2000). Available phosphorus was the highest in soils of ERU followed by that in MP and PB. The land use, management practices, parent material and its weathering could be attributed to the differences in available P of different landforms. Available P was the highest in the surface and it decreased with depth. Similar observations have been made by More *et al* (1979) in soils of Marathwada, Maharashtra. The highest available K was found in soils of PB, followed by that in ERU and MP. The differences in parent materials and K bearing minerals could be the probable reasons for such differences. The effect of K bearing minerals on available K in soils has also been reported by Pal (1985) and Patil and Sonar (1993). Within the pedon, available K was higher in the surface horizons and decreased with depth. The positive relationship of K with organic carbon could be attributed for such variation. Similar observations have been made by Pal and Singh (1993) and Kanthaliya and Bhatt (1991).

The soils of ERU had comparatively higher DTPA-Fe than the soils of MP and PB. The surface soils had higher DTPA-Fe and it decreased with

Table 1. Distribution of nutrients in the soils

Depth (cm)	Horizon	Available Macronutrients (kg ha^{-1})			Available Micronutrients (mg kg^{-1})			
		N	P_2O_5	K_2O	Fe	Mn	Zn	Cu
Eastern Rajasthan Upland								
P1 (Akola) : Loamy-skeletal, mixed, hyperthermic Lithic Ustorthents (3-8% gently sloping foot slopes of dissected hills and ridges)								
0.20	A1	201.70	12.46	297.00	5.27	6.31	0.55	0.72
P2 (Gariawas) : Loamy, mixed (calcareous), hyperthermic Typic Ustorthents (1-3% very gently sloping pediments)								
0-15	Ap	308.70	24.91	281.40	4.14	9.81	0.85	1.23
15-26	A2	247.40	19.71	384.38	3.61	9.17	0.62	0.83
26-46	AC	186.70	16.92	340.83	3.09	8.61	0.31	0.29
P3 (Chanderpura) : Loamy, mixed, hyperthermic Lithic Ustorthents (1-3% very gently sloping pediments)								
0-16	Ap	350.40	22.50	546.00	3.52	4.69	0.72	0.93
16-32	A2	219.40	20.03	428.00	2.33	3.22	0.46	0.42
P 4 (Gariawas) : Loamy-skeletal, mixed (calcareous), hyperthermic Typic Ustorthents (1-3% very gently sloping pediments)								
0-16	Ap	323.29	22.13	576.50	4.12	5.14	1.08	1.01
16-40	A2	146.00	13.62	446.80	3.38	4.82	0.67	0.63
P 5 (Kakarwa) : Fine loamy, mixed (calcareous), hyperthermic Typic Haplustepts (1-3% very gently sloping pediments)								
0-18	Ap	318.33	23.71	279.36	3.38	3.99	0.53	0.54
18-36	Bw1	178.60	20.19	227.13	2.97	3.64	0.38	0.37
36-62	Bw2	156.70	16.76	244.60	2.31	3.81	0.32	0.31
Pathar and Bundelkhand Plateau								
P6 (Manpura) : Fine, smectitic (calcareous), hyperthermic Typic Haplusterts (1-3% very gently sloping pediments)								
0-30	Ap	398.91	23.36	455.12	4.36	9.83	1.04	0.42
30-60	Bw1	267.70	18.71	375.64	3.84	9.49	0.84	0.24
60-90	Bss1	186.40	14.90	481.48	3.42	8.78	0.62	0.83
90-120	Bss2	131.93	8.34	393.27	3.09	8.61	0.31	0.35
P7 (Anoppura) : Loamy, mixed (calcareous), hyperthermic Lithic Haplustepts (3-8% gently sloping undulating upper pediments)								
0-15	Ap	288.40	25.81	663.81	3.23	4.28	0.67	0.93
15-38	Bw	195.70	18.52	384.40	2.38	3.53	0.38	0.48
P 8 (Sadi) : Loamy, mixed (calcareous), hyperthermic Typic Haplustepts (3-8% gently sloping intervening valley)								
0-17	Ap	298.81	21.18	344.23	2.48	4.31	0.75	1.02
17-40	Bw	132.00	13.62	318.86	1.69	3.25	0.41	0.58
P 9 (Kanena) : Loamy, mixed (calcareous), hyperthermic Lithic Ustorthents (1-3% very gently sloping plateau)								
0-20	Ap	235.51	17.86	288.28	2.69	4.86	0.64	1.05
P 10 (Karunda) : Loamy, mixed (calcareous), hyperthermic Lithic Haplustepts (1-3% very gentlysloping alluvial plain)								
0-13	Ap	258.61	19.70	331.96	2.81	5.21	0.71	1.21
13.32	Bw	108.40	15.88	279.55	1.92	2.92	0.41	0.39
Malwa Plateu								
P 11 (Devgarh) : Loamy-skeletal, mixed (calcareous), hyperthermic Typic Ustorthents (3-8% gently sloping plateau top)								
0-10	Ap	235.50	17.88	288.26	2.24	4.36	0.54	1.06
10.20	AC	162.35	14.76	318.35	1.72	3.72	0.32	0.64
P 12 (Suhagpura) : Clayey-skeletal, mixed (calcareous), hyperthermic Typic Ustorthents (1-3% very gently sloping plateau)								
0-10	Ap	274.22	19.60	436.81	2.79	7.24	0.68	0.68
10.20	AC	138.70	16.61	356.83	1.53	5.46	0.31	0.27
P 13 (Jaliyan) : Fine, smectitic (calcareous), hyperthetmic Typic Haplusterts (very gently sloping pediment plain)								
0-15	Ap	323.51	24.81	288.84	3.43	8.32	0.58	0.61
15-30	Bw1	286.82	25.12	279.55	3.18	7.91	0.48	0.47
30-60	Bw2	178.41	23.54	253.34	2.82	7.48	0.32	0.36
60-80	Bss	171.60	23.84	227.13	2.63	7.21	0.28	0.27
80-114	BCk	103.00	16.76	244.60	1.81	6.81	0.26	0.21
P 14 (Banekhan) : Fine, smectitic (calcareous), hyperthermic Typic Haplusterts (1-3% very gently sloping alluvial plain)								
0-25	Ap	329.44	24.88	399.22	6.21	4.67	0.38	0.87
25.40	Bw1	286.81	20.54	384.38	4.23	4.28	0.29	0.66
40.55	Bw2	208.82	17.92	340.63	4.99	4.60	0.24	0.70
55-80	Bss	158.42	12.02	323.27	3.89	3.31	0.11	0.46
80-100	BCk	120.50	10.91	370.07	2.08	2.21	0.13	0.31
P 15 (Nimbahera) : Fine-loamy, mixed (calcareous), hyperthermic Typic Haplustepts (1-3% very gently sloping pediments)								
0-17	Ap	269.89	21.50	378.17	3.38	5.27	1.41	0.96
17-37	Bw1	179.41	19.20	331.98	2.92	4.78	0.92	0.78
37-60	Bw2	108.48	15.88	279.58	2.45	3.98	0.60	0.56
60.-90	Bk	83.44	8.34	318.36	1.82	3.72	0.29	0.32

depth. A positive relationship has been observed between organic carbon and DTPA-Fe which corroborated the findings of Sharma and Chaudhary (2007). The distribution pattern of DTPA-Mn was similar to that of DTPA-Fe. The soils occurring on PB had higher DTPA-Zn as compared to soils of ERU and MP. DTPA-Zn and Cu also followed similar trend of distribution as that of Fe and Mn. DTPA-Cu was closely related to organic carbon and as per Sharma and Chaudhary (2007) decreased with depth.

References

Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of India Private Limited, New Delhi, India.

Kanthaliya, P. C and Bhatt P. L. (1986). Distribution of total and DTPA extractable nutrients in some soils of sub-humid zone. *Journal of the Indian Society of Soil Science* **39,** 781-782.

Meena, H.B., Giri, J.D. and Mishra, H.K. (2009) Suitability assessment of soils occurring on different landforms of Chittorgarh district, Rajasthan. Agropedology **19,** 75-83

More, S. D., Kachhava, K.G. and Varade, S.B. (1979). Phosphorus availability as influenced by some important properties of Veritsols of Marathwada. *Bulletin of Indian Society of Soil Science*, New Delhi. **12,** 297-299.

Page, A. L. (1986). Methods of Soil Analysis, Part II: Soil Chemical Analysis. American Society of Agronomy Inc. Wisconsin, USA.

Pal, S. K. and Singh, M. (1993). Monitoring the potassium fertility levels of four soil series from North India over a period of time. *Journal of the Indian Society of Soil Science* **41,** 674-677.

Patil, Y. M. and Sonar, K. R. (1993). Dynamics of potassium in swell-shrink soils of Maharashtra. I. The potassium fractions. *Journal of Potassium Research.* **9,** 315-324.

Raj kumar, Ahuja, R. L. Singh, N. T. and Gabhru, S. K. (1995). Characteristics and classification of alkali soils on Sivalik hills of Satluj-Yamuna divide North-west India. *Agropedology* **5,** 29.

Sharma, D. L., Moghe, V. B. and Mathur, C. M. (1968). Salinity and alkalinity problem and fertility status of soils of Pali district (Rajasthan). *Journal of the Indian Society of Soil Science* **16,** 263.

Sharma, J. C, and Chaudhary, S. K. (2007). Vertical distribution of micronutrient cations in relation to soils characteristics in lower Shivaliks of Solan in north western Himalayas. *Journal of Indian Society of Soil Science.* **55,** 40-44.

Sharma, S. S. (2000). Characterization and classification of salt affected soils for land use planning in sub-humid plains of Rajasthan. *Ph.D thesis*, RAU, Bikaner, Rajasthan.

Shyampura, R. L., Krishna, N.D.R., Ram Gopal and Giri, J.D. (1992). Genesis and characterization of soils across Ghaggar Flood Plain in Rajasthan. *Annals of Arid Zone.* **31,** 199-204.

Singh, K. S. and Ahuja, R. L. (1990). Distribution of primary nutrients in relation to soil characteristics in the Ghaggar river basin. *Journal of Indian Society of Soil Science.* **38,** 733-735.

Soil Survey Staff (2003). Keys to Soil Taxonomy, 9th edition, USDA, National Resources Conservation Service, Washington D.C.

Received : June 2008 *Accepted : April 2010*