

An Analysis of Surface Stratum Soils of the landscape of Kashmir University Campus

Irfana N. Kangroo and G. A. Bhat,

Centre of Research For Development and P.G.Deptt. of Environmental Sciences, University of Kashmir, Srinagar-190006, J&K, India.

ABSTRACT

Determination of various physico-chemical characteristics of soils in the three micro-habitats of not-much-manipulated grassland/non-floricultural area and floricultural area of Main University Campus and Chinar dominated area (Naseem Bagh) of Kashmir University ($34^{\circ} 5'$ to $34^{\circ} 6'$ N and $74^{\circ} 8'$ to $74^{\circ} 9'$ E) revealed highest amounts of exchangeable Calcium, organic Carbon, Loss on ignition in the surface soil of Naseem Bagh, and highest values of moisture content, bicarbonates, available potassium and total nitrogen in the samples of not much manipulated grassland/non-floricultural area of the main university campus, while highest values of exchangeable Calcium, Magnesium, total Phosphorus and available Phosphorus were estimated in the floricultural area. Chloride content, percent organic Carbon, percent loss on ignition were found highest in Naseem Bagh soils followed by not-much-manipulated area of the main university campus. The soils of the Naseem Bagh and that of non-floricultural area belonged to the textural class of clay, while that of the floricultural area to the class of silty clay.

Key words: Landscape, university campus, pedology.

INTRODUCTION

Garden landscape designing has currently begun to become a valued art. The skill of landscape designers is believed to be the practical organization and systematization of civil engineering, botany and pedology (Alkins et al., 1998). The garden landscape of the main campus of university of Kashmir including its Naseem Bagh, besides providing encampment for various faculties, hostels and administration, is managed for aesthetic use. For the maintenance of its aesthetic and natural scenery the information / knowledge of physical features and components of surface soil of such landscape is very much required for the landscape designers. This paper presents a preliminary data on the same subject.

STUDY SITES AND CLIMATE

The present study was conducted during April, 2003 to November 2003, in the two comparable micro-habitats, Main University Campus and Naseem Bagh Campus of Kashmir University 34° 5' to 34 ° to 6' N and 74 ° 8' 74° 9' E at an altitude of 1586 m above mean sea level. The University Campus is situated about 12 kms from the main city centre Lal-Chowk, having a natural surrounding of Himalayan mountain range in the background with a front view of world famous Dal Lake. The over all area of the campus is 86 ha. Three sites selected were designated as :

- ★ Chinar dominated woodland of Naseem Bagh campus (NBC) site S1
- ★ Not - much - manipulated grassland of the main university Campus (MUC) site S2
- ★ Floriculture area of the main university campus(MUC) site S3

The climate of the study area is temperate with four seasons a year. December, January and February making the winter; March, April and May the spring; June, July and August representing the summer and September, October, November forming the Autumn. The temperature fluctuates between minimum of -10 °C and 35 °C.

MATERIALS AND METHODS

Soil physico - chemical characteristics were determined by collecting composite surface soil samples (0-10 cm deep) by digging the earth sequentially in the three selected sites and stored in polyethylene bags for subsequent laboratory investigations. After collection, the soil samples were air-dried, lightly crushed with mortar pestle and passed through 2mm sieve for analysis (Ghosh and Kundun, 1991).

Various methods for analyses of different parameters included:

Soil texture was determined through international pipette method.

Soil pH and electrical conductivity (EC) were determined in a soil to water ratio of 1:2.5 following Gupta (2002).

Moisture content was determined as per the method prescribed by (Michael, 1984).

Measurement of field capacity were determined by the filter paper method prescribed by Colman (1947).

The organic carbon / organic matter percent was determined by rapid titration method of Walkley and Black (1934).

Loss on ignition (%) was determined by the muffle furnace method given by Hanna (1964).

Exchangeable Calcium and Magnesium were estimated in 1N ammonium acetate-shaking and filtration method (Schollenberger and Simon, 1945) followed by EDTA-titration.

Available Potassium was determined through flame photometric method prescribed by Richards (1954).

Total phosphorus was estimated following Piper (1966).

The available Phosphorus was estimated by observing Oslen et al. (1954).

Total Nitrogen of the soils was estimated by the method recommended by Jackson (1973) and Bear (1964).

Chloride, Carbonate / Bicarbonate contents were estimated by titrating the extracts of soil samples with AgNO_3 as prescribed by Richards (1954).

Soil water content was determined following the method of Gliessman (2000).

For depth and level categorization Raychudhuri (1966) was followed.

RESULTS AND DISCUSSION

Overall the pH of the surface soils was found to vary between 6.68 and 7.84 indicating a range between slightly acidic through neutral to mildly alkaline (Raychudhuri, 1966) and the same over all observation corresponded to the values selected for the Naseem Bagh Campus (S1). In the samples of not-much-manipulated/non-floricultural area of the main University Campus (Site 2) the pH values ranged between 7.00 and 7.67 i.e. through neutral to mildly alkaline while the soils of floricultural area showed neutral through mildly alkaline to strongly alkaline character i.e. 7.10 to 7.80 (Table 1).

The Electrical conductivity (dSm^{-1}) was in general found to be between the lowest of 0.31 and the highest of 1.09, the lowest value corresponding to the floricultural part of the landscape (Site S3) in April while the highest characterizing the samples of the S2 area in June.

Site wise the soil moisture content percent was found to vary between 7.00 (in September) and 22.82 (in April) in the surface soils of Site S1 (Naseem Bagh) between the highest of 19.15 (in July) and lowest of 7.87 (in September) in non-floricultural area of the main University Campus Site S2). Field moisture content in the floricultural soils (Site S3) were found to occur in the range of 12.71

Table – 1 : Physico-chemical characteristics of soils of the campus of Kashmir University

S.No	Parameters	APRIL			MAY			JUNE			JULY		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1	pH	7.25	7.23	7.50	7.50	7.47	7.80	7.74	7.11	7.43	7.84	7.67	7.57
2	Electrical Conductivity (dSm) ⁺	0.37	0.35	0.31	0.41	0.37	0.33	0.91	1.09	1.05	0.67	0.77	0.67
3	Moisture Content (%)	22.82	15.34	17.40	16.35	17.70	12.71	17.38	16.10	14.19	18.57	19.15	13.31
4	Field Capacity (%)	8.75	13.12	11.05	15.20	15.04	21.50	22.09	20.34	20.56	23.78	13.96	21.38
5	Organic Carbon (%)	0.19	0.66	2.53	0.39	1.56	0.58	0.74	2.57	2.90	1.01	0.58	0.23
6	Organic Matter (%)	0.33	1.13	4.36	0.67	2.68	0.93	1.27	4.43	4.93	1.74	0.99	0.39
7	Loss on Ignition (%)	16.36	16.14	14.48	9.55	9.52	2.50	12.50	10.44	10.00	8.44	13.1	8.47
8	Exchangeable Calcium (meq/100g)	6.08	3.90	5.90	6.40	7.15	5.90	5.90	5.20	5.42	8.60	9.20	8.80
9	Exchangeable Magnesium (meq/100g)	1.32	1.70	1.80	1.50	0.65	0.15	1.25	0.60	1.60	0.70	0.30	1.55
10	Available potassium (ppm)	41.00	158.0	177.0	76.00	136.0	112.0	143.0	223.0	219.0	196.0	112.0	97.00
11	Soil water content Om(g water/g dry soil)	0.33	0.38	0.29	0.29	0.28	0.21	0.28	0.26	0.24	0.13	0.21	0.20
12	Bicarbonates (meq/l)	0.06	0.13	0.02	0.18	0.06	0.05	0.08	0.02	0.03	2.20	2.40	2.10
13	Chloride (meq/l)	0.090	0.150	0.150	0.060	0.060	0.150	0.110	0.080	0.150	0.110	0.150	0.090
14	Available Phosphorus (ppm)	12.00	20.00	22.00	14.00	14.00	17.00	22.00	21.00	26.00	20.00	18.00	14.00
15	Total Kjeldahl Nitrogen (%)	0.014	0.028	0.195	0.030	0.120	0.044	0.056	0.198	0.240	0.078	0.044	0.017
16	Total Phosphorus (ppm)	183.0	315.0	487.0	228.0	434.0	268.0	342.0	436.0	673.0	328.0	249.0	214.0
17	Atmospheric temperature °C	24.00	25.00		25.00	27.00		28.00	30.00		30.00	31.00	
18	Soil temperature °C	25.00	26.00		26.00	28.00		28.00	29.00		29.00	30.00	

Table - 1: Continued

S.No	Parameters	AUGUST			SEPTEMBER			OCTOBER			NOVEMBER		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
1	pH	7.57	7.00	7.10	7.37	7.21	7.30	6.08	7.48	7.57	7.10	7.20	7.12
2	Electrical Conductivity (dSm) ⁻¹	0.87	0.92	0.96	0.61	0.74	0.63	0.43	0.62	0.58	0.46	0.61	0.68
3	Moisture Content (%)	7.08	8.75	16.77	7.00	7.87	14.44	8.18	8.13	15.18	11.21	8.13	25.17
4	Field Capacity (%)	29.7	37.14	17.97	20.3	33.9	9.07	16.20	31.21	11.01	18.21	23.11	13.46
5	Organic Carbon (%)	0.39	2.26	0.21	0.30	2.15	0.19	0.63	2.01	0.18	1.21	2.10	0.23
6	Organic Matter (%)	0.60	3.69	0.36	0.51	3.70	0.32	1.08	3.46	0.31	2.08	3.62	0.39
7	Loss on Ignition (%)	8.47	7.85	7.91	7.40	8.40	6.90	8.13	7.30	8.57	9.15	9.12	9.20
8	Exchangeable Calcium (meq/100g)	2.15	2.95	1.80	2.50	2.30	1.30	2.83	1.67	1.15	2.67	2.10	1.17
9	Exchangeable Magnesium (meq/100g)	1.25	1.30	2.20	1.20	1.10	1.20	1.01	1.21	1.10	0.89	1.10	1.21
10	Available potassium (ppm)	70.00	246.0	40.00	58.00	162.0	37.00	122.0	210.0	78.00	191.0	185.0	99.00
11	Soil water content Om(g water/g dry soil)	0.07	0.08	0.16	0.10	0.20	0.15	0.05	0.06	0.15	0.90	0.15	0.10
12	Bicarbonates (meq/l)	2.00	1.30	1.80	1.20	2.20	2.00	1.12	1.92	2.01	1.98	2.10	1.36
13	Chloride (meq/l)	0.110	0.150	0.009	0.080	0.007	0.051	0.090	0.030	0.021	0.012	0.150	0.030
14	Available Phosphorus (ppm)	22.00	20.00	12.00	17.00	19.00	11.00	19.00	17.00	11.00	11.00	18.00	13.00
15	Total Kjeldhal Nitrogen (%)	0.028	0.174	0.016	0.022	0.166	0.014	0.024	0.154	0.013	0.093	0.162	0.017
16	Total Phosphorus (ppm)	317.0	524.0	229.0	136.0	390.0	222.0	168.0	466.0	168.0	328.0	390.0	211.0
17	Atmospheric temperature °C	29.00	32.00		26.00	28.00		20.00		21.00	13.00	18.00	
18	Soil temperature °C	29.00	32.00		24.00	26.00		19.00		19.00	16.00	15.00	

S1 - Nuseem Bagh

S2 - Not-much - manipulated / non-floricultural area of the main university campus

S3 - Floricultural Area

(in May) and 25.17 (in November). This represented the highest range probably because of the fact that large amounts of organic manures are added to these floricultural soils. The soil of Naseem Bagh i.e. Site S1 also appeared to contain fairly higher amounts of moisture content as these also receive significant amounts of organic materials from thin leaves of the deciduous Chinar trees (*Platanus Orientalis*) on one hand and on the other hand ground surface of this area receipt of little amount of sun shine so that not much amount of moisture content evaporates from the soil of this area. It is to mention here that the Site S1 lies in the under canopy of a dense Chinar trees.

The over all variations in the percent field capacity were between 8.75 in April at site S1 and 37.14 in August at the site S2. Site wise values appeared to vary as: at site S1 between 8.75 and 29.78; at site S2 between 13.12 and 37.14 and at site S3 between 9.07 and 21.50. It will not be out of place to mention that surface soils of site S1 and those of the site S2 remain compacted and not disturbed while the soils of site S3 are periodically disturbed by way of processes of digging, hoeing etc.

Organic Carbon (%) of the overall Campus soils was estimated to vary between 0.18% and 2.90%. In Naseem Bagh soils its percent estimation was between 0.19 and 1.21; in the non-floricultural / not much manipulated site of the main campus it was represented by 0.58 and 2.57 and in the floricultural part of the University landscape the % organic carbon values were found to exist between 0.18 and 2.90. The highest % organic value of 2.90 in June at site S3 was probably due to the fact that a lot of organic matter was added to the soil. The range of loss on ignition which in crude way represents the amount of organic matter, was found to vary in a higher range at site S1 (between 7.40 and 16.36) and at site S2 (between 7.30 and 16.14) as compared to at site S3 (between 2.60 and 14.48). However percent organic matter estimations were of higher range at sites S2 (0.99 and 4.43%) and S3 (0.31 and 4.99) as compared to site S1 (0.33 and 2.08). Soil moisture content at various sites was found to be related to the loss on ignition while many authorities including Williams (1968) have demonstrated the relationship of soil moisture with the content of loss on ignition.

Total phosphorus (673 ppm) and available phosphorus (26 ppm) were recorded highest for floricultural site S3 during June and lowest 11 in S1 in the month of November. Soils of site S2 of main campus showed highest amounts of exchangeable Ca (9.20 meq / 100 gms) during July and exchangeable magnesium content of 2.20 (meq/100gms) in S2 during August while the lowest calcium content were recorded (1.17 meq/100 gms) in S3 during November and magnesium 0.15 in S3 during May. Soil water content recorded highest value in S2 during April while as the lowest in S1 in October. Available potassium (ppm) were estimated highest 248 at site S2 in August and lowest 37 at site S3 in September.

During the study carbonates were found inestimable in samples of all the three sites (S1, S2, S3) while Bicarbonates (meq/l) were found highest (2.40) at S2 in July and the lowest (0.02) at site

S3 and S2 in the months of April and June. Chloride (meq/l) were found highest (0.158) at site S3 during May and lowest (0.007) at S2 during September. Total Nitrogen(%) were determined as maximum (0.198) at S2 in June and minimum (0.013) at S3 in July. Atmospheric Temperature found highest (31°C) in S2 during July while as lowest (13°C) recorded in S1 in the month of November. Soil Temperature was found highest (32.3 °C) in S2 in the month of August and lowest (15°C) in S2 during November.

In Naseem Bagh soils (site S1) the percentage of silt is 28.83%, clay 50%, sand 21.67% and therefore showed the Textural class of clay. Similarly the Grassland soils of main campus (site S2) comes under the Textural class of clay as the percentage of silt, clay and sand is 25%, 60% and 15%. The percentage of Silt in floriculture site (site S3) is 35%, clay 48% and sand 17% and determined the Textural class of silt-clay as not much difference is in the percentage of silt and clay (Table 2).

Table 2. Texture of soils of the campus of Kashmir university

Area	Silt %	Clay %	Sand %	Textural class
Naseem Bagh S1	28.83	50	21.67	Clay
Non-floricultural site S2	25	60	15	Clay
Floricultural site S3	35	48	17	Silt-Clay

On the whole C:N ratio (Table 3) was found to vary between 12.90 and 26.20 and was characteristic of Naseem Bagh area (S1). In the non-floricultural area of the campus its range was between 12.90 and 23.57 while in the floricultural area it was comparatively narrower i.e. between 12.90 and 13.84.

Table 3. C:N ratio in the surface stratum soils of the Kashmir university campus

Site	Month							
	April	May	June	July	August	September	October	November
S1	13.57	13.00	13.20	12.90	13.90	13.63	26.20	13.01
S2	23.57	13.00	13.20	13.18	12.90	12.95	13.50	12.90
S3	12.97	13.10	12.90	13.50	13.12	13.50	13.84	13.52

In purely agricultural soils an adequate conception of the soil can be obtained only from the study of all the horizons or soil strata down to the parent material (Bear, 1964) but in case of this study which is of preliminary nature only surface layer (0 – 10 cm) soil samples were taken into consideration for analysis. Both the field as well as laboratory observations revealed that the soil of the campus is mature, belonging to moderately deep and deep and nearly level category. The non – floricultural and Naseem Bagh soils are clay while the manipulated soil of floriculture are silty clay. Higher amounts of moisture

content in the soil of floricultural plots were probably because of the fact that organic manures were being continually added and also periodic or routine irrigation was being given to these. Most other features particularly those related to the levels of total Nitrogen, total Phosphorus etc. were indicative of the fact that the soils of all the sites of the campus constitute a good garden soil.

ACKNOWLEDGEMENT

The authors are thankful to the Director CORD for providing the laboratory facilities.

REFERENCES

- Alkins, P., Simmons, I. and Roberts, B. 1998. *Metaphors and meanings in modern landscapes. People, land and time*. Arnold, London, New York, Sydney, Aukland.
- Bear, F. E. 1964. *Chemistry of the soil*. Reinhold, New York.
- Colman, E. E. 1947. A laboratory procedure for determination of field capacity of soils. *Soil Science*. **63**: 277-283.
- Ghosh, M. K. and Kundun, N. K. 1991. Soil profile studies as a part of environmental management in coal mining areas. *Indian J. Environmental Protection* **11** (6): 413 - 417.
- Gliessman, S. R. 2000. *Field and Laboratory investigation in Agro Ecology* (Eric W. Engles, ed.) Lewis Pub. New York.
- Gupta, P. K. 2002. *Soil, plant and water analysis*. Agro. Botanica Bikaner
- Hanna, W. J. 1964. Methods for chemical analysis of soils. In : *Chemistry of the soils*. (Firman E. Beas, ed.) Oxford and IBH Pub. Comp.
- Jackson, M. L. 1973. *Soil chemical analysis*. Prentice Hall of India Pvt. Ltd. New Delhi.
- Michael, P. 1984. *Ecological methods for field and laboratory investigations*. Tata Mcgraw Hill Pub. Comp. Ltd.
- Olsen, S. R. Cole, Watanable, C.V. and Dean, L.A. 1954. *Estimation of available phosphorus in soils by extraction with sodium bicarbonate USDA. circular 939*. US . Government Printing Office, Washington D.C.
- Piper, C. S. 1966. *Soil and Plant Analysis*. Hans Publisher Bombay
- Raychaudry, S. P. 1966. *Land and Soil*. National Book trust of India, New Delhi.

- Richards, L. A. 1954. *Diagnosis and improvement of saline and Alkaline soils*. USDA Handbook 60 Washington, D.C.
- Schollenberger, C. J. and Simon, R. H. 1945. Determination of exchange capacity and exchangeable bases in soil-ammonium acetate method. *Soil. Sc.* **59**: 13 - 24.
- Walkley, A. and Black, I. A. 1934. An estimation of the Degtjareff method for determining soil organic matter, and a proposed modification of the chronic acid titration method. *Soil Scio.* **34**: 29 - 38.
- William, J. J. 1968. The nitrogen relations ecological investigations on wet fertilized meadows. *Veroff. Geobot. Inst. Zurich*, **41**: 70-193.