Environment Conservation Journal 18 (1&2) 247-253, 2017
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Distribution, diversity and phytosociology of *Berberis lycium*- a medicinally important and economically valuable plant species along a riparian gradient in Jammu and Kashmir

Anu Sharma [1] Dinesh Singh [1] and Neeraj Sharma[1] ✉

Received: 28.11.2016 **Revised: 11.02.2017** **Accepted: 12.03.2017**

Abstract

The present communication deals with the distribution, diversity and phytosociology of an important medicinal shrub *Berberis lycium* along Neeru stream, a major left bank tributary of river Chenab with an elevational gradient of 848 m to 2200 m. *Berberis lycium,* during our phytosociological surveys has emerged as the most dominant species amongst its understorey associates. The highest values of IVI (180.2 & 160.6) in the riparian zone (Zone-I) were recorded for site 7 (left bank, Dranga) and site 8 (right bank upslope, Zone-II, Amiranagar), respectively. The diversity parameters revealed the highest value (H' 2.60) at Zone-II along the left bank. The soil parameters (pH, moisture content, Nitrogen, Phosphorous & Potassium) too had a profound effect on the distribution of the plant species, which has been discussed in the paper.

Key words: Berberis lycium, diversity, Neeru stream, Phytosociological surveys, Riparian zone, Understory associates

Introduction

Berberis lycium Royle, a small, erect evergreen shrub belongs to family Berberidaceae. is widely distributed in the subtropical and temperate areas of the Himalayas and is locally known as *Rasaundh* in the Chenab catchment. The first taxonomic account of family Berberidaceae for the Indian subcontinent (Hooker & Thomson, 1875) included six genera and 17 species. Plants of family Berberidaceae are famous for its medicinal importance and are included in British and Indian pharmacopeias (Srivastava *et al*., 2006 and Jan *et al*., 2011). While the plant is known to cure eye disorders, abdominal disorders, skin diseases, rheumatism, jaundice, fever, tumors etc. the berberine, a tetra quinolineisoalkaloid present in the plant shows antidiabetic effect (Gulfraz *et al*., 2008). Fruits and leaves contain high percentage of various nutritive constituents *i.e.*, protein, fat, fiber, palmitine, calcium, sulphur, berberine and vitamin C (Gupta *et al*., 2015). The fruits (Kashmal) have been used by primitive societies living in Himalayan range of Jammu and Kashmir and Himachal Pradesh since ancient times as a tea substitute and making *Chutneys* (Kaur *et al*., 2001 and Tiwari *et al*., 2010). The plant flowers during April-May and bear fruits from June to August. *B. lyceum* has been placed in vulnerable category (Waseem*et al*., 2006 and Hamayun *et al*., 2006) of International Union for Conservation of Nature (IUCN) and under endangered category by Environment Information Centre (ENVIS, 2017).

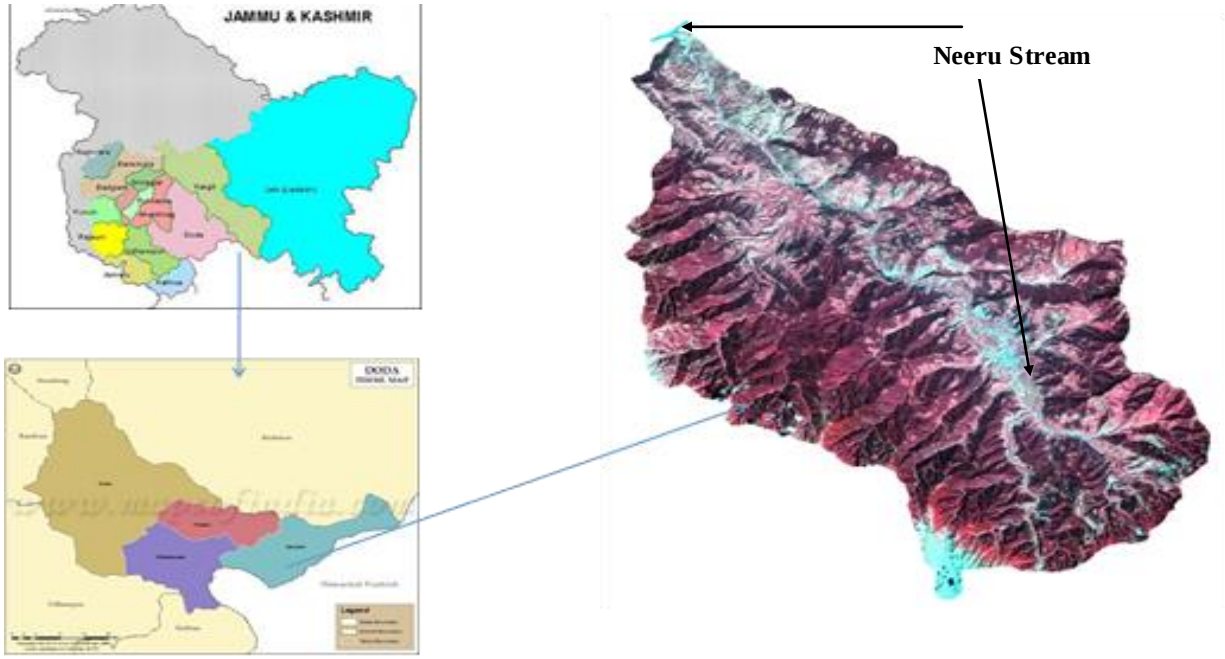
Author's Address
[1]Institute of Mountain Environment, University of Jammu
E-mail:nirazsharma@gmail.com

Materials and Method

Study area and Methodology

The study area forms the south-western part of Chenab catchment with an altitudinal range of 848 m to 2200 m lying between $32^0 55' 32'' N$ to $33^0 08' 26'' N$ and $75^0 32' 41'' E$ to $75^0 46' 50'' E$ (Map-1). The field surveys were conducted during the years 2015 and 2016. Fifteen sites were identified for the analysis of various phytosociological parameters along both banks of the stream using species area curve approach. 24 quadrats of 100 m^2 were laid each containing two quadrats of 25 m^2 in opposite corners for different parameters (frequency, density, abundance and basal area following Curtis & McIntosh, 1950 and diversity by Shannon-Weiner, 1963). For the purpose of the study, each site at each bank was divided into two

zones namely riparian (Zone-I) and upslope (Zone-II).The geo-coordinates, elevation and aspect were recorded with the help of GPS (Garmin- Montana 650) and provided site wise in Table-1. Soil analysis was performed for different parameters i.e., pH (Philips make digital pH meter), moisture content, Nitrogen (Subbiah & Asija, 1956), Phosphorus (Jackson, 1958) and Potassium (Pratt, 1965, Jackson 1958 and Peech & English 1944). Two tailed test was performed and Pearson correlation was calculated using SPSS.



Map 1 Map of the study area

Table 1- Geo-features (geo-coordinates, elevation and aspect) of the sampling sites along both banks of Neeru stream

	Right bank				Left bank			
Site name	**Latitude**	**Longitude**	**Elevation (m)**	**Aspect**	**Latitude**	**Longitude**	**Elevation (m)**	**Aspect**
Puldoda	$32^0$54.993'N	$75^0$33.383'E	850	SW	$32^0$55.007'N	$75^0$33.457'E	867	NE
Galgander	$32^0$55.030'N	$75^0$34.578'E	980	S	$32^0$55.215	$75^0$34.618'E	965	NE
Pranoo	32056.462'N	$75^0$35.290'E	1110	SE	$32^0$56.516'N	$75^0$34.892'E	1085	NW
Bhalla	$32^0$58.357'N	$75^0$36.624'E	1214	SW	$32^0$58.586'N	$75^0$36.958'E	1225	NW
Seri	$32^0$58.845'N	$75^0$38.898'E	1278	SW	$32^0$58.836'N	$75^0$37.920'E	1256	N
Drudu	$32^0$59.178'N	$75^0$39.463'E	1342	SE	$32^0$59.672'N	$75^0$39.562'E	1356	NE
Dranga	$33^0$00.099'N	$75^0$40.335'E	1382	S	$33^0$00.433'N	$75^0$45.342'E	1377	N
Amiranagar	$33^0$00.721'N	$75^0$41.576'E	1450	S	$33^0$00.745'N	$75^0$41.588'E	1419	NW
Gatha	$33^0$01.054'N	$75^0$42.046'E	1463	SE	$33^0$01.073'N	$75^0$42.098'E	1458	NE
Renda	$33^0$01.506'N	$75^0$43.380'E	1546	SE	$33^0$01.342'N	$75^0$43.087'E	1519	N
Guptganga	$33^0$03.033'N	$75^0$43.377'E	1603	SW	$33^0$3.342'N	$75^0$43.437'E	1623	N
Dareja	$33^0$04.216'N	$75^0$43.596'E	1655	SW	$33^0$04.048'N	$75^0$43.521'E	1645	NW
Bheja	$33^0$05.644'N	$75^0$45.169'E	1790	S	$33^0$05.956'N	$75^0$45.093'E	1800	NE
Thanthera	$33^0$06.359'N	$75^0$45.265'E	2163	SW	$33^0$06.487'N	$75^0$45.112'E	2150	NE
Thanalla	$33^0$08.289'N	$75^0$45.714'E	2155	S	$33^0$08.452'N	$75^0$45.785'E	2200	NW

Results and Discussion

Phytosociology

The phytosociological parameters including frequency, density, abundance and species importance value along with the diversity values of *Berberis lycium* for all the study sites have been provided in Table-2. An attempt has been made to draw a relationship between phytosociological parameters and soil characteristics for different parameters provided in Table-3. The analysis reveals that the highest value of IVI (180.2) was obtained for the riparian zone (Z-I) of left bank followed by upslope zone (Z-II) of right bank (160.6). A comparative account of observations at Z-I and Z-II of both the banks has been given as:Z-I of right bank showed the highest density of 2.5 at site-7 and 9, respectively while Z-II exhibited the maximum density of 3.0 at site-7 (Dranga). The highest IVI (160.6) was recorded for Z-II when compared with Z-I (147.3). Along the left bank, the density was observed to be highest (2.5) at site 4 and 5 (Bhalla and Seri) of Z-I whereas it was highest (2.16) at site 2 (Galgander) and 4 (Bhalla), respectively. IVI of 180.2 was noted to be higher at Z-I than Z-II (114.0). Diversity (H') was recorded to be highest (2.60) at Z-II of left bank of the stream. Soil pH ranges from 5.9-7.6 and 6.0-7.3 at right and left bank respectively. This indicates that the moderately acidic to slightly alkaline soil conditions favour the growth of the plant. The edaphic conditions revealed the soil moisture content ranging from 3.5%-4.6% on right bank and 3.9%-4.8% on the left bank, respectively. It was observed that the moisture content is less on the right bank due to its sun facing side. The values of Nitrogen (0.0 - 1529 kg/ha) and Phosphorus (0-45.04 kg/ha) increase from lower to higher elevation on the right bank whereas Potassium (85.31-363.69 kg/ha) increases from higher to lower elevation. On the left bank Nitrogen (0.0 - 1445 kg/ha) and Phosphorus (0-52.55 kg/ha) increases from lower to higher elevation and on the other hand Potassium (40.41-548.90 kg/ha) increases from higher to lower elevation. It was observed that the values of pH, moisture content, phosphorus and potassium were higher towards lower elevation which is virtually correlated with the low density, high IVI and low diversity on the right bank of the stream and vice-versa. Similar trend is noticed along the left bank of the stream. This indicates that the low pH, moderate moisture content, high N, P and medium level of K supports high density and diversity in the riparian zone of the study area. Compared with the riparian site (Z-I), density and diversity of shrubs were recorded higher towards more exposed and drier sides (Z-II) along both banks of the stream. *Berberis lycium* was found as the understory shrub in association with trees like *Alnus nitida, Ficus palmata* and *Robinia pseudo-acacia* in Z-1 and other shrub associates. While in Z-II it flourished under conifer stand like *Pinus roxburghii, Pinus wallichiana* and *Cedrus deodara*. Among shrubs the common associates were *Daphne oledeoides, Rubus ellipticus, Rubus niveus, Rosa brunoni,* and *Prinsepia utilis*. Among herbs the common associates were *Verbascum thapsus*, *Artemisiavestita, Artemisia scoparia, Trifolium repens, Trifolium pratense, Impatiensbalsamina, Ipomoeacairica, Cannabis sativa, Oenotherea purpurea, Oenotherea rosea, Fragaria nubicola, Urtica dioica* etc. The statistical analysis showed that the IVI of left bank is negatively correlated with the rising elevation whereas IVI of right bank is positively correlated at 99% level of confidence (Table 4). Since the left bank is on the South-west aspect and faces lesser sunshine the IVI (dominance) is therefore lesser on the left bank of the stream indicating the diverse nature of the site. Left bank is more diverse than the right bank as indicated by the correlation established between IVI and elevation. The obvious reasons for this kind of trend are the different environmental variables like aspect, decrease in the moisture content and rising elevation. Various phytosociological characteristics like species composition, species diversity and similarity have been analyzed. Many such studies have been conducted for trees, shrubs and herbs of Himalayan region in India, Nepal as well as Pakistan. Rawat & Chandra (2014) while studying the vegetational diversity across different habitats in Garhwal Himalayas reported the maximum diversity, richness and density of trees and herbs on the stream bank whereas shrubs were reported higher on the dry site. This goes well with our present study where *Berberis lycium* shows the maximum density and diversity at Z-II of both the banks of the stream. In yet another study by Sharma

Table 2- Diversity and phytosociology of *Berberislycium* along both banks of Neeru stream

	Right Bank										Left Bank									
	Riparian Zone (Zone-I)					Upslope zone (Zone-II)					Riparian Zone (Zone-I)					Upslope zone (Zone-II)				
Site name	Freq	Den	Abd	IVI	H'	Freq	Den	Abd	IVI	H'	Freq	Den	Abd	IVI	H'	Freq	Den	Abd	IVI	H'
Puldoda	66.67	1.5	2.25	102.7	0.99	83.33	1.83	2.2	112.6	1.57	50	0.66	1.33	172.3	0.69	66.67	1.0	1.5	55.38	1.81
Galgander	83.33	2.33	2.8	147.3	0.68	66.67	1.66	2.5	109.6	0.99	83.33	2.16	2.6	162.7	0.69	83.33	2.16	2.6	114.0	1.09
Pranoo	83.33	2.33	2.8	141.8	0.89	83.33	2.66	3.2	110.7	1.31	66.67	2.0	3.0	75.95	1.35	83.33	1.66	2.0	57.26	1.90
Bhalla	83.33	1.83	2.2	80.36	1.36	83.33	1.83	2.2	88.31	1.66	100	2.5	2.5	108.3	1.35	83.33	2.16	2.6	64.2	2.35
Seri	83.33	2.33	2.8	104.6	1.56	83.33	1.66	2.0	76.01	1.88	100	2.5	2.5	91.2	1.87	83.33	1.5	1.8	38.88	2.60
Drudu	66.67	1.66	2.5	84.48	1.25	100	2.16	2.16	106.0	1.64	50	1.66	2.33	53.7	1.94	83.33	1.33	1.6	53.2	2.32
Dranga	83.33	2.5	3.0	87.55	1.75	100	3.0	3.0	160.6	0.97	83.33	1.83	2.2	71.26	1.57	83.33	1.5	1.8	54.45	2.36
Amiranagar	83.33	2.16	2.6	89.74	1.53	66.67	1.66	2.0	70.87	1.52	83.33	1.66	2.0	180.2	0.69	66.67	1.33	2.0	64.07	1.90
Gatha	83.33	2.5	3.0	132.6	0.91	66.67	1.66	2.5	135.2	0.68	66.67	1.66	2.5	121.8	1.02	66.67	1.33	2.0	56.78	1.89
Renda	83.33	1.83	2.2	111.1	1.09	66.67	1.66	2.5	86.58	1.55	66.67	1.33	2.0	81.51	1.57	66.67	1.5	2.25	60.76	1.85
Guptganga	83.33	2.16	2.6	95.86	1.33	83.33	2.0	2.4	100.1	1.41	66.67	1.33	2.0	101.7	1.33	100	1.66	1.666	99.67	1.56
Dareja	66.67	1.66	2.5	104.2	1.06	83.33	1.83	2.2	112.8	1.45	66.67	1.33	2.0	99.95	1.54	83.33	1.16	1.4	72.38	1.70
Bheja	83.33	2.16	2.6	122.2	1.09	66.67	2.16	3.25	72.35	1.93	66.67	1.33	2.0	110.3	1.08	66.67	1.33	2.0	69.61	2.16
Thanthera	66.67	2.0	3.0	113.2	1.08	66.67	1.5	2.25	49.74	2.22	33.33	0.83	2.5	87.14	1.36	66.67	1.83	2.75	67.31	1.99
Thanalla	66.67	1.5	2.25	84.11	1.33	83.33	1.66	2.0	67.9	2.09	50.0	1.0	2.0	130.5	1.05	66.67	1.33	2.0	70.18	1.52

Where H'- Shanon Weiner's Diversity Index

Table-3 Values of soil parameters for different sampling sites on the right and left banks of Neeru stream

Soil Parameters										
	Right Bank					Left Bank				
Sampling Site	pH	M (%)	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	pH	M (%)	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)
Puldoda	**7.6**	**4.67**	41.70 (L)	37.54(H)	**363.69 (H)**	**7.3**	4.58	Absent	15.01 (M)	87.55(L)
Galgander	7.1	4.22	111.20 (L)	22.52(M)	161.64 (M)	6.8	4.25	6.95 (L)	45.04 (H)	103.27(L)
Pranoo	6.9	4.66	Absent	30.03(H)	96.27 (L)	6.9	**4.83**	750.60(H)	45.04 (H)	65.10(L)
Bhalla	6.8	4.58	444.80(M)	30.03(H)	102.14 (L)	6.7	4.52	83.40 (L)	45.04 (H)	297.46(H)
Seri	6.6	4.07	361.40(M)	15.01(M)	105.51 (L)	6.7	4.36	125.10 (L)	7.50 (L)	76.33(L)
Drudu	6.7	4.18	166.80 (L)	30.03(H)	85.31 (L)	6.5	4.63	291.90(M)	30.03 (H)	52.75(L)
Dranga	6.6	4.27	236.30 (L)	22.52(M)	116.74 (L)	6.5	4.63	708.90(H)	30.03 (H)	**548.9(H)**
Amiranagar	6.2	4.36	653.30 (H)	22.52(M)	188.58(M)	6.3	4.26	125.10 (l)	Absent	61.73 (L)
Gatha	6.3	4.49	312.75(M)	7.50 (L)	130.21(M)	6.2	4.63	145.95 (L)	45.04 (H)	40.41(L)
Renda	6.3	4.23	437.8(M)	Absent	95.41 (L)	6.1	4.39	778.40(H)	7.50 (L)	57.24(L)
Guptganga	6.2	4.30	1112.00(L)	37.54(H)	96.53 (L)	6.1	4.44	771.45(H)	37.54 (H)	111.12(M)
Dareja	6.1	4.21	882.65 (H)	22.52(M)	169.49(M)	6.1	4.24	674.15(H)	37.54 (H)	204.29(M)
Bheja	5.9	3.83	966.05 (H)	**45.04(H)**	104.39 (L)	6.3	3.98	417.00(M)	Absent	78.57(L)
Thanthera	6.2	3.75	611.60 (H)	15.01(M)	97.65 (L)	6.0	3.96	**1445.6(H)**	**52.55 (H)**	176.23(M)
Thanalla	6.1	3.55	**1529.0 (H)**	30.03(H)	232.35 (M)	6.0	3.91	827.05(H)	**52.55 (H)**	133.57(M)

Table 4- Pearson correlation between IVI and Elevation at Right and Left bank of the stream

Values		IVI(RB)	Elevation (RB)	IVI (LB)	Elevation (LB)
IVI (Right Bank)	Pearson Correlation		-.229	.113	-.251
	Sig. (2-tailed)		.411	.688	.367
	N	15	15	15	15
Elevation (Right bank)	Pearson Correlation	-.229		-.231	.999**
	Sig. (2-tailed)	.411		.408	.000
	N	15	15	15	15
IVI (Left bank)	Pearson Correlation	.113	-.231		-.224
	Sig. (2-tailed)	.688	.408		.422
	N	15	15	15	15
Elevation (Left bank)	Pearson Correlation	-.251	.999**	-.224	
	Sig. (2-tailed)	.367	.000	.422	
	N	15	15	15	15

et al., 2014 *Berberis aristata* and *Berberis jaeschkeana* showed the highest density percentages in the Sangla valley of Northwest Himalayas. They owed this to the high adaptive tendency and good capability of the shrub to proliferate in extreme climate of the Western Himalayan region. Diversity of shrubs in the present study was also reported to be higher on the dry site (Z-II) of both the banks of the stream in the study area. Bijalwan *et al*. (2009) have done phytosociological analysis of overstory and understory woody perennials along with aspects in Balandi watershed of mixed dry tropical forest in Chhattisgarh plain. They concluded that aspect plays an important role in the structure and dominance in the phytodiversity. The diversity

index is generally higher in tropical forests, which is reported as 5.06 and 5.40 for young and old stands respectively (Knight, 1975) while for Indian forests (Parthasarathy *et al*., 1992 and Sahu *et al*., 2012) value ranged between 0.83 to 4.1 and for temperate forests between 1.16 to 3.40 (Braun, 1950; Monk, 1967 and Pande *et al*., 1996). Altitude and aspect are the most important determinants of vegetation distribution due to their direct impact on microclimate of the habitat (Rawal & Pangtey, 1994 and Singh *et al*., 2009). The Himalayan region has typical topography and environment where biodiversity varies from aspect to aspect and habitats of the communities (Shank & Noorie, 1950). Soil moisture gradient is influenced by the soil characteristics such as; texture, argil type, horizons borderline, structure, solution salts, gravely, depth, and soil temperature. Also, soil moisture changes in term of topography (elevation, aspect, and slope) and the other factors such as micro topography, amount of litter on soil surface etc. (Zare Chahouki *et al*., 2008). Srivastava *et al*., 2008 reported that the community characters differ among aspect, slope, and altitude even in the same vegetation type.

Conclusion

Berberis lycium is a hardy species which grows almost in every habitat. It is distributed almost uniformly throughout the study area with lesser variation in the distribution pattern. The shrub is found to be widely distributed at all the sites ranging from 848 m a near sub-tropical zone to 2200 m along both the banks of the Neeru stream with a defined distribution along the changing environmental variables, especially the edaphic conditions and elevation. Because of its immense medicinal and economic properties the plant should be given due protection in its wild habitat. The shrub requires special attention which includes its propagation and conservation in the region on modern scientific lines.

Acknowledgements

The authors are highly thankful to Rector Bhaderwah Campus, University of Jammu for providing the necessary facilities for the field surveys. The help rendered by the department of Forests, Govt. of Jammu and Kashmir is gratefully acknowledged and appreciated. The support of Muzaffar Ahmed Kichloo and Adil Najeeb during the field investigations is deeply acknowledged.

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