Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(4): 339-342
Received: 13-05-2017
Accepted: 12-06-2017

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Effect of grazing on floristic composition at selected site (grazed site- Yousmarag) in Kashmir Valley, India

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Abstract
Kashmir Valley has vast land area (16%) under grasslands which play an important role in providing economic goods and ecosystem services to the society. Livestock, particularly the migratory flocks, are entirely dependent on these grasslands. They serve as bedrock for sustaining the core economic activity of livestock rearing in the region. Apart from sustaining this pivotal economic activity, grasslands harbour a rich and endemic biodiversity, and regulate the regional carbon, nutrient and hydrological cycles (Masoodi, 2003 [8]; Anonymous, 2014) [1]. The data pertaining to Grazed site (Yousmarag) revealed the presence of twenty four herb species in spring season, the highest density was shown by *Cynodon dactylon* (415800 ha^{-1}), maximum frequency (100%) was observed by *Achillea mill folium* and highest abundance was reported in *Cynodon dactylon* (554200 ha^{-1}). It is evident from the data that out of the twenty four herbaceous species a total of nineteen were recorded in summer season, the highest density was shown by *Cynodon dactylon* (554200 ha^{-1}), the maximum frequency (100%) was observed in *Cynodon dactylon* while maximum abundance was reported in *Cynodon dactylon* (554200 ha^{-1}). A total of nineteen herbs species were found in autumn season amongst the twenty four species reported at this site. Maximum density was recorded in *Cynodon dactylon* (284100 ha^{-1}), maximum frequency (100%) were recorded in *Cynodon dactylon*, while highest abundance was reported in *Cynodon dactylon* (284100 ha^{-1}). In all three seasons, it was observed that *Cynodon dactylon* had maximum importance value index (IVI). IVI for Cynodon dactylon was maximum in autumn (64.20 ha^{-1}) season followed by summer (58.42 ha^{-1}) and minimum was in spring (39.39 ha^{-1}).

Keywords: grasslands, grazing, density, frequency and importance value index (IVI).

Introduction
In the Indian Himalaya, the grasslands occupy about 35% of the geographical area. The different types of the Himalayan grasslands include the warm temperate grasslands, cold temperate and subalpine grasslands, alpine meadows, the steppes of cold-arid regions, and the alpine scrub. Although, they differ from one another in terms of origin, structure and composition; nevertheless they all support a large number of wild herbivores, domestic livestock, and agro-pastoral activities (Rawat, 1998) [12]. The Indian Himalaya system comprises various mountain ranges which run parallel to each other, and contains a tremendous diversity in ecology, terrain, elevation, climate, resource availability, ethnicity, agricultural activities, flora and fauna. Steep topography, prolonged and severe cold winters, shallow soils and lack of irrigation etc., have limited the choice of agricultural activities, with livestock rearing being one of the most important occupations in the region. The temperate/alpine pastures are spread across elevations higher than 2000 m in the Eastern and Western Himalayas including Jammu and Kashmir, Himachal Pradesh, Uttarakhand, West Bengal, Arunachal Pradesh and Sikkim states. The alpine and subalpine meadows suffer from general degradation, with an increasing incidence of unpalatable species and erosion due to overgrazing. These grasslands and pastures, besides being a major source of forage for livestock, provide habitat for a large variety of wild animals and birds, and for endangered species of plants, many of which have an ethnobotanic value (Roy AK; Singh JP. 2013) [13]. In recent studies (Singh *et al*. 2009; 2011) [17, 18], the monitoring and mapping of grasslands of the Himalayan region (Himachal Pradesh, Sikkim, Jammu and Kashmir states) during 2007−12 with modern tools and techniques, viz. GIS, RS, GPS and FSGT, were used in conjunction with ground-truthing to assess the extent of grasslands and their productivity. A reconnaissance survey of the grasslands of India was conducted from 1954 to 1962, revealing 5 major ecosystems based on vegetation composition and distribution, primarily governed by climatic factors, latitude, elevation, topography and seasonal patterns of soil moisture (Dabadghao and Shankaranarayan 1973) [4]. The 5 types were: Sehima - Dichanthium

grasslands; Dichanthium - Cenchrus - Lasiurus grasslands; Phragmites - Saccharum - Imperata grasslands; Themeda - Arundinella grasslands; and temperate/alpine grasslands. In Himachal Pradesh (IRSP6L3 2008), grasslands occur on 16.5% of the total area, occupying 15.3, 21.6, 18.0 and 15.3% of geo-climatic zones 1 (Low hill subtropical), 2 (Mid-hill sub-humid), 3 (Mid-hill temperate wet) and 4 (High hill temperate), respectively. Forage production from high hills was recorded as 4.0 t/ha/yr (fresh weight) and 1.1 t/ha/yr (dry matter), with an average crude protein concentration of 11.3% (Singh *et al*. 2009) [18]. In Jammu and Kashmir (IRSP6L3 2009 and 2010 data), 4.3% of the total geographical area was under productive grasslands, whereas the area of other grazing lands, including scrub and other unpalatable swards, was 9.8% of the total. The areas under productive grasslands in Jammu, Kashmir and Ladakh were 3.5, 13.2 and 5.8%, respectively. India's livestock sector is one of the largest in the world, with a livestock population around 623 M, which is expected to grow at a rate of 0.55% in the coming years. India has 56.7% of the world's buffaloes, 12.5% of the cattle, 20.4% of the small ruminants, 2.4% of the camels, 1.4% of the equines, 1.5% of the pigs and 3.1% of the poultry. The livestock population, over the years, has shown a steady growth on 2 broad fronts, namely: (i) in the number of stall-fed bovine livestock, including buffaloes and crossbred cows, owned mainly by people with arable land and resources to grow or procure green fodder; and (ii) in the number of small ruminants like goats and sheep, surviving mainly by free grazing the available pasture lands and tree foliage (Anon. 2011) [2].

Materials and Methods

The valley of Kashmir is situated in western Himalayan range, extends between 32°-20' to 34°-54' N latitude and 73° - 55' to 75° - 35' E longitude. The total geographical area of the valley is about 159480 km^{-2} with the total forest area of 8126 km^{-2} (50.95 %), with an average altitude of 1850 m asl. The minimum and maximum temperature ranged between – 4.41 ^{O}C in January to 29.34 ^{O}C in July respectively. The average annual precipitation ranges between 949 –1,100 mm mostly in the form of snow, which covers the mountainous belts for 160 - 195 days/year. The present investigation was conducted at Grazed site of Yousmarag area of Budgam district in Jammu and Kashmir, India during 2014-2015 with the aim to study the effect of grazing on floristic composition of selected site.

Floristic composition

Presence or absence of species was recorded during each sampling season at selected site (Curtis and McIntosh, 1950) [3].

Density

Density number of individuals of a species that occurs within a given sample unit or study area. It was recorded as:

$$\text{Density} = \frac{\text{Number of individuals of the species}}{\text{Total number of quadrats studied}}$$

Frequency

Frequency is the number of times a plant species is present in a given number of sample units. It was calculated by the formula:

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats in which the species occurred}}{\text{Total number of quadrants studied}} \times 100$$

Abundance

Abundance is a component of biodiversity and refers to how common or rare a species is relative to other species in a defined location or community. It was calculated by the formula:

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Number of quadrants in which the species occurred}} \times 100$$

Importance Value Index

This index is used to determine the overall importance of each species in the community structure. The important value index (IVI) for each site was worked out by using formula given by Misra (1968).

IVI = RF + RD + RA

Where,

$$\text{RF (relative frequency)} = \frac{\text{Frequency of individual species}}{\text{Frequency of all species}} \times 100$$

$$\text{RD (relative density)} = \frac{\text{Density of individual species}}{\text{Density of all species}} \times 100$$

$$\text{RA (relative abundance)} = \frac{\text{Abundance of individual species}}{\text{Abundances of all species}} \times 100$$

Result and Discussion

1. Spring season

Amongst all the twenty four species of herbs all of them were found in this season with highest density shown by *Cynodon dactylon* (415800 ha^{-1}) followed by *Taraxacum officinale* (182500 ha^{-1}), *Rumex nepalensis* (152500 ha^{-1}), *Trifolium pretense* (132500 ha^{-1}), and *Potentilla nepalensis* (112500 ha^{-1}) and lowest by *Fragaria nubicola* (22500 ha^{-1}), *Silene* sp. (22500 ha^{-1}) (Table-1). Maximum frequency (100%) was found in *Achillea millifolium, Cirsium* sp., *Cynodon dactylon, Nepata* sp., *Plantigo lanceolata, Plantigo major, Poa perennis, Poa pratensis, Potentilla nepalensis* and *Trifolium pretense* and least in *Cerastium vulgatum* **(**33.33%) (Table-3). Maximum abundance was shown by *Cynodon dactylon* (415800 ha^{-1}) followed by *Rumex nepalensis* (228800 ha^{-1}), *Taraxacum officinale* (199100 ha^{-1}), *Rumex dentatus* (141400 ha^{-1}) and *Trifolium pretense* (132500 ha^{-1}) and the lowest by *Fragaria nubicola* (54100 ha^{-1}) and *Silene* sp. (54100 ha^{-1}) (Table-2). Among these species, maximum IVI was shown by *Cynodon dactylon* (39.39 ha^{-1}) followed by *Taraxacum officinale* (22.65 ha^{-1}), *Rumex nepalensis* (18.87 ha^{-1}), *Trifolium pretense* (18.23 ha^{-1}) and *Potentilla nepalensis* (16.26 ha^{-1}) and *Cerastium vulgatum* has the lowest IVI (4.04 ha^{-1}) in this season (Table-4).

2. Summer season

The data collected at this site revealed the presence of nineteen species in summer season. Maximum density was recorded in *Cynodon dactylon* (554200 ha^{-1}), followed by *Poa annua* (193300 ha^{-1}), *Poa pratensis* (174200 ha^{-1}), *Trifolium pretense* (173300 ha^{-1}), *Stipa siberica* (149000 ha^{-1}) and the least in *Malva neglecta* (30800 ha^{-1}) (Table-1). Maximum frequency (100%) was observed in *Cirsium* sp., *Cynodon dactylon, Matricaria chamomilla, Plantago lanceolata, Plantago major, Poa annua, Poa pratensis, Polygonum heterophyllum, Potentilla nepalensis, Trifolium pretense* and

Urtica dioeca, whereas, minimum in *Malva neglecta* (41.66%), *Mentha spicata* (41.66%) and *Taraxacum officinale* (41.66%) (Table-2). Maximum abundance was reported in *Cynodon dactylon* (554200 ha^{-1}) followed by *Poa annua* (193300 ha^{-1}), *Poa pratensis* (174200 ha^{-1}), *Trifolium pratense* (173300 ha^{-1}), and *Stipa siberica* (149000 ha^{-1}), whereas, minimum in *Polygonum hydropiper* (57100 ha^{-1}) (Table-3). In this season maximum IVI was recorded for *Cynodon dactylon* (58.42 ha^{-1}), *Poa perennis* (23.44 ha^{-1}), *Poa pratensis* (22.16 ha^{-1}), *Trifolium pretense* (21.58 ha^{-1}) and *Cirsium* sp. (17.46 ha^{-1}) and least in *Malva neglecta* (6.36 ha^{-1}) (Table-4). However, *Achillea millifolium*, *Cerastium vulgatum*, *Fragaria nubicola*, *Nepata* sp. and *Rumex dentatus* were not reported in this season.

3. Autumn season

Out of twenty four species found at this site only nineteen where reported in this season with *Cynodon dactylon* showing maximum density (284100 ha^{-1}) followed by *Trifolium pratense* (80800 ha^{-1}), *Urtica dioeca* (64100 ha^{-1}), *Medicago denticulata* (57500 ha^{-1}), *Malva neglecta* (47500 ha^{-1}),whereas minimum in *Plantago lanceolata* (15800 ha^{-1}) (Table-1). Maximum frequency (100%) was observed in *Cynodon dactylon*, *Plantago lanceolata*, *Plantago major*, *Potentilla nepalensis*, *Trifolium pretense* and *Urtica dioeca* and minimum in *Silene* sp. (25%) (Table-2). The most abundant species at this site was *Cynodon dactylon* (284100 ha^{-1}), followed by *Malva neglecta* (142500 ha^{-1}), *Medicago denticulata* (98600 ha^{-1}), *Trifolium pratense* (80800 ha^{-1}) and *Stipa siberica* (78100 ha^{-1}) and minimum in *Plantigo lanceolata* (15800 ha^{-1}) (Table-3). During this season *Cynodon dactylon* showed maximum IVI (64.20 ha^{-1}) followed by *Trifolium pretense* (26.03 ha^{-1}), *Potentilla nepalensis* (21.27 ha^{-1}), *Poa annua* (17.05 ha^{-1}) and *Medicago denticulate* (16.37 ha^{-1}) and minimum in *Silene* sp. (3.68 ha^{-1}) (Table-4). However, *Achillea millifolium*, *Cerastium vulgatum*, *Fragaria nubicola*, *Nepata* sp., *Rumex dentatus* were not found in this season.

Table 1: Density (ha^{-1}) under different seasons at Grazed site in Kashmir Valley.

S. No.	Name of the Species	Spring	Summer	Autumn
1	*Achillea millifolium*	52500	-	-
2	*Cerastium vulgatum*	24100	-	-
3	*Cirsium* sp.	65200	114200	29100
4	*Cynodon dactylon*	415800	554200	284100
5	*Fragaria nubicola*	22500	-	-
6	*Malva neglecta*	82500	30800	47500
7	*Matricaria chamomilla*	32500	70800	25800
8	*Medicago denticulata*	43300	90800	57500
9	*Mentha spicata*	30800	41600	17500
10	*Nepata* sp.	91600	-	-
11	*Plantigo lanceolata*	83300	61600	15800
12	*Plantigo major*	64100	92500	26600
13	*Poa annua*	81600	193300	37500
14	*Poa pratensis*	65800	174200	30800
15	*Polygonum heterophyllum*	72500	42500	22500
16	*Polygonum hydropiper*	50800	33300	21600
17	*Potentilla nepalensis*	112500	124200	52500
18	*Rumex dentatus*	82500	-	-
19	*Rumex nepalensis*	152500	64100	31600
20	*Silene* sp.	22500	32500	9100
21	*Stipa siberica*	52500	124100	32500
22	*Taraxacum officinale*	182500	52500	20800
23	*Trifolium pratense*	132500	173300	80800
24	*Urtica dioeca*	42500	115000	64100

Table 2: Frequency (ha^{-1}) under different seasons at Grazed site in Kashmir Valley.

S. No.	Name of the species	Spring	Summer	Autumn
1	*Achillea millifolium*	100	-	-
2	*Cerastium vulgatum*	33.33	-	-
3	*Cirsium* sp.	100	100	50
4	*Cynodon dactylon*	100	100	100
5	*Fragaria nubicola*	41.66	-	-
6	*Malva neglecta*	91.66	41.66	33.33
7	*Matricaria chamomilla*	58.33	100	58.33
8	*Medicago denticulata*	58.33	66.66	58.33
9	*Mentha spicata*	50	41.66	41.66
10	*Nepata* sp.	100	-	-
11	*Plantigo lanceolata*	100	100	100
12	*Plantigo major*	100	100	100
13	*Poa annua*	100	100	91.66
14	*Poa pratensis*	100	100	83.33
15	*Polygonum heterophyllum*	83.33	100	83.33
16	*Polygonum hydropiper*	75	58.33	41.66
17	*Potentilla nepalensis*	100	100	100
18	*Rumex dentatus*	58.33	-	-
19	*Rumex nepalensis*	66.66	58.33	50
20	*Silene* sp.	41.66	50	25
21	*Stipa siberica*	41.66	83.33	41.66
22	*Taraxacum officinale*	91.66	41.66	50
23	*Trifolium pratense*	100	100	100
24	*Urtica dioeca*	50	100	100

Table 3: Abundance (ha^{-1}) under different seasons at Grazed site in Kashmir Valley.

S. No.	Name of the species	Spring	Summer	Autumn
1	*Achillea millifolium*	52300	-	-
2	*Cerastium vulgatum*	72500	-	-
3	*Cirsium* sp.	65200	114200	58300
4	*Cynodon dactylon*	415800	554200	284100
5	*Fragaria nubicola*	54100	-	-
6	*Malva neglecta*	90200	74200	142500
7	*Matricaria chamomilla*	55700	70800	44300
8	*Medicago denticulata*	74200	136300	98600
9	*Mentha spicata*	61700	100200	42300
10	*Nepata* sp.	91700	-	-
11	*Plantigo lanceolata*	83300	61700	15800
12	*Plantigo major*	64200	92500	26600
13	*Poa annua*	81700	193300	41700
14	*Poa pratensis*	65800	174200	37200
15	*Polygonum heterophyllum*	87300	42500	27100
16	*Polygonum hydropiper*	67800	57100	50500
17	*Potentilla nepalensis*	112500	124200	52500
18	*Rumex dentatus*	141400	-	-
19	*Rumex nepalensis*	228800	110200	63300
20	*Silene* sp.	54100	65100	36700
21	*Stipa siberica*	126000	149000	78100
22	*Taraxacum officinale*	199100	126000	41700
23	*Trifolium pratense*	132500	173300	80800
24	*Urtica dioeca*	85300	115200	64100

Table 4: Importance Value Index under different seasons at Grazed site in Kashmir Valley.

S. No.	Name of the species	Spring	Summer	Autumn
1	*Achillea millifolium*	10.30	-	-
2	*Cerastium vulgatum*	4.04	-	-
3	*Cirsium* sp.	11.47	17.46	11.25
4	*Cynodon dactylon*	39.39	58.42	64.20
5	*Fragaria nubicola*	4.28	-	-
6	*Malva neglecta*	13.82	6.36	12.70
7	*Matricaria chamomilla*	6.91	12.97	10.48
8	*Medicago denticulata*	7.39	12.44	16.37
9	*Mentha spicata*	5.63	6.55	6.88

10	*Nepata* sp.	15.32	-	-
11	*Plantigo lanceolata*	13.89	11.98	10.47
12	*Plantigo major*	12.89	14.65	14.40
13	*Poa annua*	13.96	23.44	17.05
14	*Poa pratensis*	13.01	22.16	14.04
15	*Polygonum heterophyllum*	11.85	10.92	11.02
16	*Polygonum hydropiper*	9.86	7.37	8.09
17	*Potentilla nepalensis*	16.26	16.59	21.27
18	*Rumex dentatus*	11.03	-	-
19	*Rumex nepalensis*	18.87	9.33	11.13
20	*Silene* sp.	4.81	6.77	3.68
21	*Stipa siberica*	7.11	16.27	9.93
22	*Taraxacum officinale*	22.65	8.29	8.02
23	*Trifolium pratense*	18.23	21.58	26.03
24	*Urtica dioeca*	7.04	16.49	23.03

Discussion

Grazing animals affect the performances of plants directly and indirectly. Direct impacts of grazing, which were associated with alteration in plant composition, plant physiology and morphology resulted from defoliation and trampling by grazers. The indirect impacts stimulate plant responses to defoliation in many ways which were not readily simulated by clipping experiments. The major goal of the study is to understand that how grazing affects the structure of plant community, biomass production and soil organic carbon. The IVI of the *Cynodon dactylon* (Table 4) was higher in the all three prominent seasons while maximum was in autumn season (64.20 ha^{-1}). Although density as well as frequency and abundance were also recorded maximum for *Cyanodon dactylon* (table 1, 2 and 3). *Cyanodon dactylon* makes good quality hay and haylage. As a fine-stemmed leafy species, *Cyanodon dactylon* cures quickly. It can be tightly packed in bales and maintain good nutritive value during storage (Hacker *et al*., 1998) [5]. *Cyanodon dactylon* is a valuable fodder grass that can be grazed (it withstands heavy grazing) or used in cut-and-carry systems. It is useful for hay, silage and pelletizing. It may be used for soil conservation (as a soil binder) and as lawn and turf grass (Ecocrop, 2012; Cook *et al*., 2005; Hanna, 1992) [6].

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