*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **3(1),** 38-42, January **(2014)** *Int. Res. J. Environment Sci.*

A Study of Seasonal Variation in Biomass of three Medicinal Plants (*Malva Neglecta, Rumex Patientia* and *Taraxacum Officinale*) of Kashmir Valley, India

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Available online at: www.isca.in, www.isca.me
Received 1st January 2014, revised 9th January 2014, accepted 20th January 2014

Abstract

The study of natural biotic community is a pre-requisite to understand the structural as well as functional attributes to locate for better landscape management. Study on biomass is essential for estimating net primary productivity of any species. The increasing trend of total utilizations of forests and its products has created the need to estimate the total biomass production in matter basis rather than conventional volume estimate. Therefore, estimation of biomass stands as a pre-requisite for better resource utilization. An attempt was made to estimate the seasonal trend of three important medicinal plants Malva Neglecta, Rumex Patientia and Taraxacum Officinale, with respect to their biomass status from protected and degraded sites of the Kashmir valley. The harvest method was used to estimate the biomass of the selected medicinal plants. Variations in biomass were observed in all the three selected medicinal plants from season to season. The quantitative investigation on biomass estimation revealed that there is need for conservation and management followed by regular monitoring because of the degradation of ground flora due to anthropogenic and animal activities.

Keywords: Biomass, conservation, grazing, medicinal plants.

Introduction

The vast and varied natural resources are essential for the subsistence and well being of human kind. Among the natural resources the forest resources occupy a unique and important position[1]. Ecologically, some species assume importance for their conservation because they provide adequate areas of appropriately varied habitat supporting viable population, hence are responsible for biodiversity of the area[2]. Each species has not only its ecological amplitude but also possess its specific relationship with its biotic and abiotic environment[3]. Therefore each species utilizes different portion of the available resource/space, wherein they have competitive advantages over others or species partition thus limiting resource in such a way that each is limited by different of the available resource[4,5].

Forest composition, community structure and diversity patterns are important ecological attributes significantly correlated with prevailing environmental as well as anthropogenic variables[6, 7]. The forest diversity patterns and governing environmental as well as anthropogenic variables in the Himalayan subtropical region have been studied by many phytosociologists[8-10].

Biomass is regarded as the characterization of an ecosystem, since it reflects the ecosystem capacity during a certain time span in accumulating organic matter[5]. The composition of vegetation at the landscape level in a microclimate is influenced by various biotic factors. Among the biotic factors, grazing is having a profound effect that influences the vegetation at a local scale[11]. Although many plant species are not resilient to grazing, there are reports of plants responding to herbivory with increased growth compared with that of un grazed plants[12,13]. However, as grazing intensity increases, losses of biomass will reach levels that cannot be maintained by re-growth and productivity, leading to a decline in biodiversity of the area[14].

Certain medicinal plants and their extracts have been used to cure different diseases. It has been observed that medicinal plants are widely used in various developing countries for the wellbeing of people [15]. The valley of Kashmir is said to have provided opportunity for sustaining the Unani system of medicine during the onslaught of the western system. Ethno medicine is a promising field of research in Kashmir, as the valley grows varied medicinal and aromatic plants including those used in curing such dreadful diseases as cancer[16]. There is an increasing trend in the use of medicinal plants both in developed and developing nations[17, 18]. Some important products obtained from various medicinal plants include alkaloids, glycosides, resins, gums, mucilage's etc[19]. Providing the better avenues of sustainable marketing for medicinal plants can enhance their commercial scale cultivation and utilisation[20].

In this study an attempt was made to estimate the seasonal trend in biomass of three important medicinal plants *Malva Neglecta, Rumex Patientia* and *Taraxacum Officinale* from protected and grazing sites of the Kashmir valley.

Material and Methods

Description of Study Sites: The Valley of Kashmir, an intermontane depression between the Pir Panjal and The Central Himalayan ranges is a deep asymmetrical basin of immense scenic beauty. Kashmir valley lying between the coordinates of $33^0.20'$ and $34^0.54'$N latitudes and $73^o.55'$ and $75^0.35'$E longitudes, covers an area of 15,948 sq. km. The Valley at Srinagar is at an altitude of about 1600 m; with rainfall of about 76cm/annum. Altitude influences the temperature, average minimum record of -12^0C in Feb. and average maximum of 37^0C in July. The sprawl of forests and the species of trees and herbs found here in are directly influenced by the lithology, rock-structure, altitude, aspect of slope, insulation and the general edhaphic and geological conditions[20]. The influence of these factors is quite pronounced in the state of J & K. Consequently, there is a great heterogeneity in the flora of the state and marked variation in their density and spatial distribution. In general, the southern slopes of Pir-Panjal have thin cover of vegetation while the northern sheltered are covered with thick conifer forests[16]. Keeping in view the above factors, the present study was carried at three different localities of Kashmir Valley. Two sites were selected in district Srinagar (College campus and Dhara theed) and the third site is located in Shopian district which is forest. The description of selected sites is described as under:

Site 1: S P College Campus Srinagar (Protected Site): S P College Campus, Srinagar. It lies at an altitude of about 156m, within geographical co-ordinates of 34^0 5'and 34^0 6' N latitude and 74^0 8'and 74^0 9' E longitude. The area is fenced completely and has been protected from any disturbance for the last few years. The site is a sunny open place and is well drained and flat.

Site 2: Heerpora Shopian (Forest site) Moderately Degraded Site: Heerpora forest lies on the north-eastern outskirts of the protected area Heerpora Wildlife Sanctuary and forms its gateway. The site lies between $33^0$30' and $33^0$42' N latitude and $74^0$31' and $74^0$43' E longitude, about 65km from Srinagar city. The forest is spread over the undulating terrain of the Pir Panjal Mountains encompasses an area of around 341.25sq.km.

Site 3: Dhara theed (Grazing Site) Degraded Site: The site is located 23 km away from Srinagar city within geographical co-ordinates of 34˚ 10' 1" N latitudes and 74˚ 54' 33"E longitudes. Human habitations are close to the site and are under pressure from both anthropogenic as well as livestock grazing. Microclimates and topographic features make the site favorable for the growth of plants especially medicinal.

The ecological studies of the selected medicinal plants at both protected and disturbed / degraded sites were conducted randomly using quadrat method. Three medicinal plants *(Malva neglecta, Rumex patientia,* and *Taraxacum officinale*) were selected for the assessment of biomass production, in three different sites of Kashmir valley on monthly basis from July to November 2009.

Biomass Estimation: The harvest method was used to estimate the biomass of the selected medicinal plants. The above ground biomass was estimated by harvesting vegetation from the quadrats of 1m x1m size. For the estimation of underground biomass, pits of size 25 x 25 x 30cm were dug out in the quadrat area. The collected plants were divided into root and shoot. All the components were cleaned and the weight of fresh matter (FM) of the collected plants was immediately measured at the field using a potable electronic balance. The samples were kept in labeled and sealed polythene bags and were taken to the laboratory for dry matter (DM) estimation. The samples were oven dried at 80^0C for 48 hours. After 48 hours, samples were weighed and presented on oven dry weight basis to estimate the dry matter (DM) present. The dried samples were weighed again and again till the concordant values were obtained[21].

Results and Discussion

Results obtained during the study period for seasonal variation in biomass estimates of three selected plants are depicted in tables (1-3). The detailed species wise results are described as under:

Malva neglecta: The maximum total fresh matter (37.59gm/m^2) was recorded during winter at site 1 and minimum total fresh matter (7.51 gm/m^2) was recorded during autumn at site 3. In case of total dry matter, maximum value of (14.92 gm/m^2) was recorded in winter at site 1 & minimum total dry matter (1.83 gm/m^2) was recorded at Site 2 in the winter season.

Rumex patientia: *Rumex patientia* showed the seasonal variations as under: The total fresh matter showed a maximum value (139.85gm/m^2) in the winter season at Site 1 and minimum value (13.07 gm/m^2) was recorded in autumn season at Site 3. The total dry matter showed maximum value (37.85 gm/m^2) at Site 2 in autumn season and minimum value (3.45 gm/m^2) was recorded at Site 3 in autumn.

Taraxacum officinale: *Taraxacum officinale* also showed considerable seasonal variations with a maximum total fresh matter (82.27 gm/m^2) in summer season at Site 1 and minimum value (12.26 gm/m^2) was recorded in the summer season at site 3.

Both maximum (18.02 gm/m^2) and minimum (3.21 gm/m^2) of total dry matter was recorded in summer season at Site 1 and Site 3 respectively.

Table-1
Seasonal Variation in Biomass of the selected plants at site 1 (College campus)

Season	Name of the species	Fresh Matter (gm/m^2)		Total Fresh Matter (TFM)	Dry Matter (gm/m^2)		Total Dry Matter (TDM)
		Root	Shoot		Root	Shoot	
Summer	*Malva neglecta*	6.25	21.45	27.70	1.68	14.39	8.87
	Rumex Patientia	21.1	61.7	82.81	6.00	19.7	25.7
	Taraxacum officinale	26.1	29.17	82.27	6.17	11.85	18.02
Autumn	*Malva neglecta*	5.07	14.02	19.02	1.54	4.57	12.24
	Rumex Patientia	45.92	81.33	127.24	11.59	18.82	30.61
	Taraxacum officinale	17.74	32.85	50.66	3.88	7.45	11.34
Winter	*Malva neglecta*	11.71	25.88	37.59	4.55	10.36	14.92
	Rumex Patientia	55.81	83.92	139.85	12.72	14.44	27.16
	Taraxacum officinale	24.00	47.86	71.86	4.93	10.22	15.15

Table-2
Seasonal Variation in Biomass of the selected plants at site 2 (Heerpora Forest)

Season	Name of the species	Fresh matter (gm/m^2)		*Total Fresh Matter (TFM)*	Dry Matter (gm/m^2)		*Total Dry Matter (TDM)*
		Root	Shoot		Root	Shoot	
Summer	*Malva neglecta*	8.32	17.64	25.96	2.65	7.22	9.87
	Rumex Patientia	26.82	35.36	62.18	10.32	8.06	18.38
	Taraxacum officinale	16.11	23.60	39.73	3.64	8.06	11.71
Autumn	*Malva neglecta*	3.63	5.42	9.05	1.02	1.85	7.19
	Rumex Patientia	72.96	40.33	113.29	29.95	7.89	37.85
	Taraxacum officinale	6.26	7.99	14.25	2.12	2.05	4.17
Winter	*Malva neglecta*	3.28	5.18	8.46	0.98	1.05	1.83
	Rumex Patientia	71.67	35.58	107.25	28.48	7.20	35.68
	Taraxacum officinale	9.4	10.65	20.05	3.12	2.3	5.42

Table-3
Seasonal Variation in Biomass of the selected plants at site 3 (Dharatheed)

Season	Name of the species	Fresh matter (gm/m^2)		Total Fresh Matter (TFM)	Dry Matter (gm/m^2)		Total Dry Matter (TDM)
		Root	Shoot		Root	Shoot	
Summer	*Malva neglecta*	3.7	8.85	12.25	1.125	2.82	3.95
	Rumex Patientia	11.83	8.96	20.78	3.40	2.28	5.68
	Taraxacum officinale	5.94	6.32	12.26	1.76	1.55	3.21
Autumn	*Malva neglecta*	2.40	5.11	7.51	0.91	2.12	3.03
	Rumex Patientia	8.65	4.42	13.07	2.25	1.20	3.45
	Taraxacum officinale	7.34	10.73	18.07	2.35	2.83	5.18
Winter	*Malva neglecta*	-	-	-	-	-	-
	Rumex Patientia	10.54	3.42	13.96	2.55	0.92	3.47
	Taraxacum officinale	6.34	9.35	15.69	3.13	2.32	4.29

Discussion: The biomasses of any ecological system are governed by climatic conditions and edhaphic characteristics to which phenology and floristic diversity are closely related. The existence of a species in a particular habitat depends not only upon its ecological adaptations but also on the associated species and the abiotic environment[22]. Within a given community, certain plant species are taken as forage, while others are avoided by herbivores. In the present study the biomass of the three species showed considerable variations. Maximum biomass was recorded at the College Campus. This may be due to less biotic interference. However, at the College Campus the biomass also varied from season to season. Both above ground and below ground biomass showed considerable variations. The maximum above ground biomass was recorded in autumn and winter seasons. In the winter season the below ground biomass showed a considerable increase. The reason for this is that since root biomass changes significantly with abiotic factors, major ground flora is being of short duration slowly complete their life cycle and disappear from the scene[2, 23]. Roots respond immediately to better soil moisture conditions and thus the biomass values are greater for roots in winter season[24]. Another reason for the maximum biomass in underground parts in winter may be due to translocation of the primary materials from the above ground parts to the underground parts[1]. Thus, resulting an increase in root biomass of the plant species, particularly in *Rumex patientia.*

In summer the plant species showed a reduction in the biomass of both underground and aboveground parts. It is reported that in summer most of the plant parts dry owing to stress of high temperature and low moisture, leading to reduction in the biomass[25]. However, in case of *Taraxacum officinale* maximum biomass was reported in summer at sites 1 and 2.At locale scales, certain plant species are avoided by the grazers leading to increase in biomass. Similar results were reported for *Taraxacum officinale* at site 3 (Dhara theed) in winter season. This increase in biomass at the Grazing site may be due to avoidance of *Taraxacum officinale* by herbivores[12].

Abiotic factors such as moisture and temperature gradients led to variations in biomass across large scale and at fine scale because of livestock disturbances[26]. Similar pattern pertaining to the present study was reported at the degraded site (Grazing site). By progressive grazing most leaves of the different species were consumed by the grazing animals as a result of which overall above ground biomass decreased. Similarly, while comparing standing total and green biomass on the non-grazed site and grazed site, the biomass at both sites varied significantly due to livestock grazing[27].

At Heerpora forest (site 2), three medicinal plants recorded low biomass values as compared with the biomass values recorded at the protected site (College Campus). This may be due to the competition for available resources in the forest area. Since, the existence and growth of a species in a particular habitat depends not only upon its ecological adaptations but also on the associated species and the abiotic environment. In the forest community the herbaceous community has to compete for resource availability[24]. Combined with the human disturbance in the area, leads to decrease in biomass in the study area. The contribution of *Rumex patientia* to the maximum biomass production at all the three sites can be attributed as, *Rumex patientia* is abundantly found in and around moist places. After the onset of rains with favourable soil moisture and favouring climatic conditions and rainy conditions, annuals, and new shoot arrive from perennial, resulting in rapid biomass build up[4, 13].

Conclusion

It is evident from the results that the overall ecological studies of the selected medicinal plants in three different localities differ greatly. Except College Campus, other two sites reflect disturbances of the habitat due to over exploitation and grazing. The quantitative investigation on ecological studies reveals that there is need for conservation and management followed by regular monitoring because of the degradation of ground flora due to anthropogenic and animals' activities.

To protect degraded environment and fragile ground flora ecosystem, it may be suggested that the practice of gardening, agro forestry or social forestry could result in sustainable production to local people and protection of forest resources.

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