Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 2926-2929
Received: 01-03-2019
Accepted: 05-04-2019

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Biomass estimation of herbaceous species of Benhama area, Kashmir

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Abstract
The present study entitled "Biomass estimation of herbaceous species of Benhama Ganderbal, Kashmir" was conducted at Faculty of forestry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Benhama, Ganderbal, Jammu and Kashmir during the year 2015-2016 with the aim to assess the biomass of herbaceous species at this site. Study site was divided into three altitudes. At each altitude, five quadrats were laid of size 1.25 m x 1.25 m for herbaceous species. The floristic surveys conducted in the study area during the study period resulted in the identification of 64 herbaceous species belonging to 18 families. The aboveground biomass of different grasses present at different elevations revealed that the maximum production was at lower elevation followed by middle and upper elevations with the maximum contribution from *Cynodon dactylon* at all the three altitudes. It is followed by *Conyza canadensis*, *Rumex histatus* and *Poa bulbosa* in the lower, middle and upper altitude respectively.

Keywords: Altitude, biomass**,** herbaceous species

Introduction
Biomass production, one of the functional parameters of a community, is reflection of its diversity of species and their adaptation to the prevailing environment. Biomass is an important attribute of vegetation for several reasons. Biomass of rangelands and pasturelands is necessary for carrying capacity estimation. Biomass of crops is essential for land productivity prediction. Biomass of herbs, shrubs and trees is vital for herbivores and therefore for their subsequent predators and ecosystem management. More importantly, after the Kyoto Protocol entered into force, in 2005, the demand for 'carbon credits' has been escalating in the international market. Under these circumstances, an accurate estimation of biomass is becoming vital for selling carbon into national and international markets. Plant biomass is often used to evaluate ecosystem function for land management[3], as it can provide a straight-forward metric of plant community health as well as standing fuel load for fire management decision- making. Biomass is a key structural variable in the investigations of the dynamics of the ecosystems, the level of biodiversity they sustain, their role in the carbon cycle, and their sustainability [9]. In addition, the quantification of aboveground biomass resources constitutes necessary information for numerous studies, including the analysis of fixed-emission of CO_2 [6]. There is an increasing need to improve the accuracy of biomass estimates as they determine the actual amount of carbon reaching the atmosphere [1]. Jammu and Kashmir with significant population of Gujjar and Bakerwal communities is facing more intense problem of grazing and consequently grasslands have degraded to a significant extend. Due to the lack of sound management plan for the development of pasture land and protection of existing patches of grassland, the value of these grasslands have not even been fully documented in terms of their biodiversity.

Materials and Methods
The "Vegetation Analysis and Biomass estimation" was conducted at Faculty campus of Faculty of Forestry located at Benhama, Ganderbal, Jammu and Kashmir spread over 50 ha at an altitude of 1720m-1843m above mean sea level. The plantation site lies on the southern aspect at 34^0-16'N and 74^0- 46'E longitude. The existing land of the study site composed of three types of land problems namely: degraded underutilized (scrub dominated), degraded pastures/grazing lands, barren rocky/stony wasteland. The study site falls in a mid to high altitude characterized by hot summers and very cold winters. The soil formation and soil deposits are essential pre-requisites for the growth and nature of plant life. The effect of climate, topography, parent rock material and time are important in soil formation and soil texture.

The soil of the study site is sandy loam in texture; high in organic carbon with slightly neutral in pH and normal in electrical conductivity [8].

The present study on vegetation analysis was carried out by dividing the whole area of selected site (50 hactares) into three altitudes; Lower altitude: 1720 meters-1761 meters above mean sea level ; Mid altitude: 1761 meters-1802 meters above mean sea level; Upper altitude: 1802 metres-1841 meters above mean sea level.

Methodology used

The direct field plot harvest method [7] was used. The application of this method, though more difficult and less cost effective especially in large scale mapping is traditionally the most accurate, since it is based on direct field sampling. Study site was divided into three altitudes in order to cover more and more area. Five quadrats of size 1.25 m x 1.25 m were laid down per altitude and all herbaceous plant species were harvested. The harvested plant species material were placed in separate polyethylene bags and transported to the laboratory for identification and biomass determination. Before laboratory analysis, all the vegetation components were washed thoroughly under a jet of running water so as to remove the attached soil.

Laboratory studies involved dry weight determination of all collected samples of plant species. Samples of all plant species, were weighed and oven dried to constant weight in a hot air-circulating oven at 105ºC. After 24 hours, samples were weighed and presented on oven dry weight basis to estimate the dry matter present. Observations were recorded for fresh and dry weight of herbaceous species of Benhama area of Ganderbal district of Kashmir.

Results

The data tabulated in the Table-01 pertaining to different elevations of Benhama, Ganderbal gives the biomass production of different herbaceous species. An insight of the data showed that the aboveground biomass varied from a minimum of 20.14 q/ha (upper elevation) to a maximum of 45.08 q/ha (lower elevation).

An insight of the data explicated that the total aboveground biomass production of herbaceous species in lower elevation ranged from 0.32 q/ha to 2.16 q/ha. A perusal of data explicated that the total aboveground biomass in lower elevation was 46.08 q/ha with the species *Cynodon dactylon* (2.16 q/ha) contributing to the maximum biomass production followed by *Conyza Canadensis* (1.76 q/ha), *Rumex hisatus* (1.37 q/ha), *Salvia moorcraftiana* (1.23 q/ha), and *Verbascum thapsus* (1.17q/ha). The least contribution was of *Asplenium spp*. (0.32 q/ha), *Gallium aparine* (0.35 q/ha) and *Geranium pratense* (0.36 q/ha).

The total aboveground biomass production of herbaceous species in middle elevation ranged from 0.31q/ha to 1.87q/ha. An insight of the data showed that the aboveground biomass in middle elevation was 36.66 q/ha with the species *Cynodon dactylon* (1.87q/ha) contributing to the maximum biomass followed by *Rumex hisatus* (1.49q/ha), *Capsella bursa pastoris* (1.21q/ha), and *Conyza canadensis* (1.11q/ha) respectively. The least contribution was of *Gallium aparine* (0.31q/ha), *Brumus inermis* (0.39q/ha), *Utrica dioica* (0.41q/ha), *Euphorbia helioscopia* (0.43q/ha) and *Veronica persica* (0.43q/ha).

An insight of the data showed that the total aboveground biomass production of herbaceous species at upper elevation ranged from 0.33q/ha to 1.29q/ha. A perusal of data explicated that the total aboveground biomass in upper elevation was 20.14 q/ha with the species *Cynodon dactylon* (1.29 q/ha) contributing to the maximum biomass followed by *Poa bulbusa* (0.99q/ha), *Poa annua* (0.91q/ha), and *Verbascum thapsus* (0.87q/ha) respectively. The least contribution was of *Veronica persica* (0.33q/ha), *Utrica dioica* (0.33q/ha), *Euphorbia helioscopia* (0.36q/ha), and *Stellaria media* (0.38q/ha).

Table 1: Aboveground biomass (qha^{-1}) of herbaceous species at different elevations in Benhama, Ganderbal, Kashmir

S. No.	Species	LOWER (1720m-1761m amsl)	MIDDLE (1761m-1802m amsl)	UPPER (1802m-1843m amsl)	AVERAGE (Mean±S.E)
1	*Achillea millefolium*	0.64	-	-	0.21 ± 0.10
2	*Ajuga parviflora*	0.73	-	-	0.24 ± 0.12
3	*Amaranthus viridis*	1.11	1.01	-	0.71 ± 0.35
4	*Artemisia indica*	1.05	1.01	-	0.69 ± 0.35
5	*Artemisia maritime*	-	0.74	-	0.25 ± 0.27
6	*Artemisia abscinthium*	1.05	0.97	-	0.67 ± 0.33
7	*Asplenium spp*	0.32	-	-	0.11 ± 0.06
8	*Avena fatua*	0.38	0.44	0.46	0.43 ± 0.02
9	*Brumus japonicas*	0.41	0.39	0.39	0.34 ± 0.02
10	*Capsella bursa pastoris*	0.7	1.21	0.58	0.83 ± 0.03
11	*Cirsium arvense*	0.58	0.53	0.49	0.53 ± 0.02
12	*Centurea iberica*	0.64	0.66	0.59	0.63 ± 0.02
13	*Chenopodium album*	0.82	0.79	-	0.54± 0.26
14	*Clinopodium umbrossum*	0.65	-	-	0.22 ± 0.11
15	*Convolvulus arvense*	0.58	0.51	0.49	0.53 ± 0.02
16	*Conyza Canadensis*	1.76	1.11	0.79	1.09 ± 0.11
17	*Crepis spp*	-	-	0.61	0.20 ± 0.20
18	*Chaerophyllum villossum*	0.92	0.87	-	0.59 ± 0.29
19	*Cynoglossum lanceolatum*	0.57	0.5	-	0.36 ± 0.17
20	*Cynodon dactylon*	2.16	1.87	1.29	1.77± 0.34
21	*Daccus carrota*	0.49	0.41	-	0.30 ± 0.12
22	*Echinochola colunum*	0.62	0.59	-	0.40 ± 0.20
23	*Erodium cicutarium*	0.59	0.52	-	0.37 ± 0.18
24	*Euphorbia helioscopia*	0.47	0.43	0.36	0.42 ± 0.03
25	*Gallium aparine*	0.35	0.31	-	0.22 ± 0.11

26	*Geranium pratense*	0.36	0.53	-	0.30 ± 0.15
27	*Hypericum perforatum*	0.63	-	-	0.21 ± 0.11
28	*Lactuca dissecta*	-	0.65	0.56	0.40 ± 0.20
29	*Lepidium rudrale*	0.67	0.59	0.65	0.64 ± 0.04
30	*Lespediza capitata*	0.58	0.49	0.43	0.50 ± 0.04
31	*Lollium spp*	0.69	0.64	0.53	0.62 ± 0.04
32	*Marubium vulgare*	0.89	0.76	-	0.55 ± 0.27
33	*Matricaria chamomilla*	0.57	0.51	0.47	0.52 ± 0.03
34	*Medicago minima*	0.6	0.52	0.49	0.54 ± 0.03
35	*Medicago polymorpha*	0.5	-	-	0.17 ± 0.01
36	*Meliotus alba*	0.57	-	-	0.19 ± 0.10
37	*Myosotis arvensis*	0.56	-	-	0.19 ± 0.07
38	*Oenothera rosea*	1.04	1.04	0.77	0.95 ± 0.09
39	*Oxalis corniculata*	0.77	0.67	0.47	0.64 ± 0.08
40	*Papaver roseaus*	0.58	-	-	0.19 ± 0.08
41	*Plantago lanceolata*	0.74	0.66	0.53	0.64 ± 0.06
42	*Poa bulbusa*	0.89	0.78	0.99	0.89 ± 0.06
43	*Poa annua*	0.97	0.83	0.91	0.90 ± 0.04
44	*Polygonum plebium*	0.63	0.53	0.49	0.55 ± 0.04
45	*Prunella vulgaris*	0.67	0.64	-	0.44 ± 0.21
46	*Ranunculus arvense*	0.57	0.51	-	0.36 ± 0.18
47	*Rhumex histatus*	1.37	1.49	0.78	1.46 ± 0.09
48	*Rubdosia rugosa*	0.77	-	-	0.26 ± 0.13
49	*Rumex nepalensis*	0.93	0.89	-	0.61 ± 0.30
50	*Salvia moorcraftiana*	1.23	1.01	0.79	1.01 ± 0.13
51	*Scandix pectin veneris*	0.72	-	-	0.24 ± 0.14
52	*Sochus oleraceous*	0.63	0.61	0.46	0.57 ± 0.05
53	*Solanum nigrum*	0.71	0.67	-	0.46 ± 0.23
54	*Sorghum halepensis*	0.85	0.82	0.72	0.80 ± 0.03
55	*Stellaria media*	0.57	0.45	0.38	0.47 ± 0.05
56	*Taraxicum officinale*	0.72	0.66	0.43	0.60 ± 0.08
57	*Thymus linearis*	0.69	0.57	-	0.42 ± 0.21
58	*Trifolium pratense*	0.56	0.47	0.45	0.49 ± 0.03
59	*Trifolium repens*	0.69	0.62	0.52	0.61 ± 0.04
60	*Utrica dioica*	0.42	0.41	0.33	0.39 ± 0.02
61	*Verbascum thapsus*	1.17	1.10	0.87	1.05 ± 0.09
62	*Veronica persica*	0.66	0.43	0.33	0.47 ± 0.09
63	*Vicia sepia*	0.41	-	-	0.14 ± 0.01
64	*Xanthium spinosum*	0.91	0.88	0.74	0.84 ± 0.05
TOTAL		45.08	36.66	20.14	33.97

Discussion

The area encompassing Benhama, Ganderbal, Kashmir has sparse human population at higher altitudes but they possess fairly rich livestock population which make the study site prone to grazing. The data on productivity estimates at the study sites are depicted in Table 14. An insight of the data shows that the aboveground biomass of different herbs at Benhama, Ganderbal, varied from a minimum of (20.14q/ha) at upper altitude (1841m and amsl) to the maximum of (46.12 q/ha) at lower altitude (1722m-1782m amsl) and therefore it was found out that the overall biomass content shows a decreasing trend with the increase in elevation. The decrease in biomass of herbage along the three altitudes of study site is the expression of decrease in diversity and density of herbage at three altitudes as they were strongly correlated to aboveground biomass of herbage. Many workers have contended that there is decline in biomass production of plant communities with increase in elevation due to change in environment along the altitude [2, 4]. These results are also in accordance with the findings of a study [5] in the Langate Forest Division of Kashmir, during the year 2002-2003. The grazed areas showed low biomass values compared to the protected ones for all the seasons. The plant biomass for protected areas was maximum in summer (1221.56 g/m^2) and minimum in winter (290.62 g/m^2) as against grazed areas having maximum value (590.81 g/m^2) in autumn and minimum (183.75 g/m^2) in winter.

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