

Floristic diversity and seasonal variation of herbaceous species in *Taxus contorta* bearing stands of Kashmir Himalayas

ABSTRACT

The present study was carried out during the 2022-2023 to assess the floristic diversity and seasonal variation of herbaceous species dominance in *Taxus contorta* stands of Kashmir Himalayas. A total of 9 sites were selected across the Kashmir Himalayan region viz., S1-Pahalgam (Northwest), S2-Vastoorwan (Southeast), S3-Daksum (Northeast), S4-Naranag (Northeast), S5-Ganidobh (Southwest), S6-Gund (Northeast), S7-Tangmarg (Northwest), S8-Lolab (Southeast) and S9-Gulmarg (Northwest). The sampling was done by purposive sampling and three quadrants of size 1m×1m were laid and a total of 57 herb species belonging to 23 families were reported from each study site. The highest total density (71000 N/ha) of herbs was reported in summer season at Ganidobh site followed by density at Lolab (62333 N/ha) and Vastoorwan (59667 N/ha). Lowest density was recorded at Daksum site in autumn season (32333 N/ha). The study revealed the seasonal variation in the Importance Value Index (IVI) of herbaceous species across study sites. In the spring season, *Phytolacca acinosa* showed the highest IVI at S3 (23.34) and S2 (22.13), followed by *Plantago lanceolata* (21.54) and *Conyza canadensis* (20.71) at S3. The lowest IVI values were recorded for *Polygonum heterophyllum* (3.39) at S6 and *Viola odorata* at S9 (3.08). During the summer season, *Phytolacca acinosa* maintained dominance with an IVI of 27.52 at S3, while *Cannabis sativa* had notable values at S6 (19.58) and S4 (19.13). The lowest values were observed for *Thymus linearis* (3.57) at S9 and *Myosotis arvensis* (3.20) at S2. Similarly, in the autumn season, *Phytolacca acinosa* again recorded the highest IVI (28.34) at S3, while *Plantago lanceolata* (23.44) and *Oxalis corniculata* (21.56) were prominent. The lowest IVI values included *Daucus carota* (2.21) at S2 and *Festuca rubra* (2.94) at S6. The IVI of herb species depends upon the density, basal area and frequency at the site.

Keywords: Diversity, Herbs, Spring, Dominance, Density, IVI, Kashmir

1. INTRODUCTION

The Kashmir Himalaya, situated in the northwestern part of the Himalayan region, is renowned for its diverse landscapes, encompassing forests, meadows and glaciers (Dar & Khuroo, 2020; Khuroo, 2015). Due to its wide range of habitats, the region is considered one of the most ecologically complex and biologically rich areas within the Himalayan Biodiversity Hotspot (Dar & Parthasarathy, 2022; Haq *et al.*, 2020). Its topographical diversity and broad altitude range contribute significantly to its vast floristic variety (Mir *et al.*, 2020). Although the region accounts for only 0.4% of India's land area, it hosts 12% of the nation's angiosperm species, emphasizing its remarkable biodiversity (Dar & Khuroo, 2013). However, like other Himalayan regions, Kashmir's biodiversity is under significant threat from multiple factors. Over recent decades, several plant species have become endangered due to habitat destruction, fragmentation, deforestation, overgrazing, invasive species, overexploitation, changes in land use, increased tourism, road construction and political instability (Dar, 2008; Khuroo *et al.*, 2018; Tali *et al.*, 2019; Hamid *et al.*, 2020; Mir *et al.*, 2020). Various national and international campaigns have

been launched to combat the global biodiversity crisis (Kullberg & Moilanen, 2014). Recognizing the importance of biodiversity, the Convention on Biological Diversity (CBD) established a goal in 2010 to conserve 17% of terrestrial areas under Protected Area (PA) Networks by 2020 (Saura *et al.*, 2019).

Several plant species in the Kashmir Himalaya are vital for the Indian pharmaceutical industry. However, their populations are declining due to unsustainable harvesting. Among these is the Western Himalayan yew (*Taxus contorta*), an endangered species with medicinal significance. Previously classified as *Taxus baccata* and later as *Taxus wallichiana*, this species is known locally as "Poshtul" in Kashmiri and "Birmi" in Dogri. It grows naturally in shady, sheltered locations at altitudes ranging from 1,700 to 3,300 masl, the associated species are *Quercus semecarpifolia* (Kharshu) and *Abies pindrow* (Silver Fir), *Picea smithiana* (Spruce), *Cedrus deodara* (Deodar), and *Quercus dilatata* (Moru Oak). In the eastern Himalayas, it often grows alongside *Abies pindrow* and *Rhododendron species*. This dioecious, evergreen species *Taxus contorta* can regenerate through seeds, this process is hindered by slow germination, rapid loss of seed viability and low survival rates (Pande *et al.*, 2002; Rajewski *et al.*, 2000). Efforts to conserve this species are essential for preserving its ecological and medicinal value.

The Kashmir Valley's geography is further enriched by the Jhelum River, which, along with its tributaries, is a major source of irrigation. The Valley's diverse habitats include rivers, lakes, springs, marshes, cultivated fields, orchards, graveyards, forests, alpine meadows and glaciers. Its temperate climate is characterized by four distinct seasons: wet, cold winters (December-February), mild springs (March-May), warm summers (June-August) and cool autumns (September-November). To address gaps in understanding, the present study was undertaken to assess the floristic diversity and seasonal variations of herbaceous species in the forests of Kashmir.

1. MATERIALS AND METHODS

2.1 Study area

Kashmir valley is located in the north-western extremity of India, between 33° North latitude and 75° East longitude. The valley is located in the northern most latitude of the country holds almost central position in the continent of Asia. Average altitude of Kashmir valley (valley zone) ranges between 1,500 to 2,300 m above sea level. The geographical expanse of Kashmir is 15,948.00 sq km. A study "Floristic diversity and seasonal variation of herbaceous species in *Taxus contorta* stands of Kashmir Himalayas" was carried out across the Kashmir valley. The 3 sites were selected for study from each 3 regions.

Table 1: Study site characteristics

Region	Sites		Aspect	Altitude(m)
South Kashmir	Pahalgam	S1	Northwest	2741
	Vastoorwan	S2	Southeas	1872

	Daksum	S3	Northeast	2992
Central Kashmir	Naranag	S4	Northeast	2624
	Ganidobh	S5	Souhwest	2128
	Gund	S6	Northeast	1774
North Kashmir	Tangmarg	S7	Northwest	2173
	Lolab	S8	Southeast	1851
	Gulmarg	S9	Northwest	2652

1.2. Sampling procedure and Vegetational analysis

Sampling was done by purposive sampling at the 9 locations across the valley. Phytosociological attributes of herbage were carried out in spring, summer and autumn season from 3 quadrates of size 1x1 m in each sampling plot. The samples collected were brought to the laboratory, washed properly with fresh running water and segregated species-wise. The individuals of each species from different quadrates were counted separately and their basal area was calculated following (Phillips, 1959). The various observations recorded as:

i. Floristic composition

Presence or absence of species recorded during the spring, summer and autumn season.

ii. Density

Density was recorded as the number of tillers per unit area following (Misra, 1968).

iii. Frequency (%)

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

iv. Basal area (Misra, 1968)

$$\text{Basal area} = \frac{\pi d^2}{4}, \text{ where } d = \text{Diameter of tillers}$$

v. Importance Value Index (IVI):

This index was used to determine the overall importance of each species in the community structure. In calculating this index, the percentage values of the relative frequency, relative density and relative dominance or basal area were summed up together and this value was designated as the Importance Value Index or IVI of the species (Misra, 1968)

Important Value Index = Relative Density (RD) + Relative Frequency (RF)
+ Relative basal area (RBA)

2. RESULTS & DISCUSSION

The present study was conducted in *Taxus* dominated stands across the Kashmir Valley during the year 2022-2023. During the study 57 herb species were reported among them the maximum herb species were reported from the Ganidobh site (39), Lolab (36) and Vastoorwan (35) at the southwest and southeast aspect. The Importance Value Index (IVI) of herbs at different sites is presented for spring season in (Table 2), for summer season (Table 3) and autumn season (Table 4) and the density of herbs recorded highest in summer season at the southwest aspect of Ganidobh site, followed by Southeast aspects of Vastoorwan and Lolab, then northwest of Pahalgam, Tangmarg and Gumarg. The lowest density was recorded in autumn season at the Northeast aspect of Daksum site (Fig. 1).

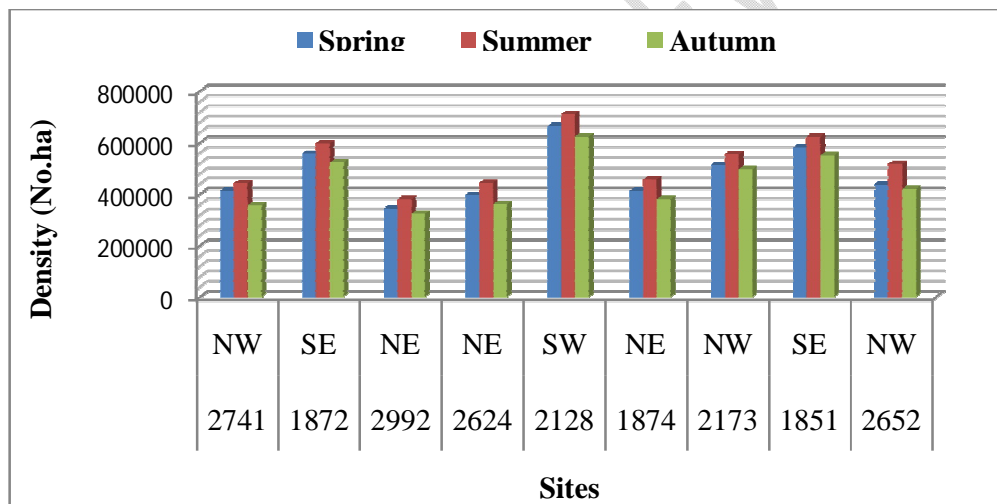


Fig. 1: Density of herb species at different sites in spring, summer and autumn season

The study reported that the *Phytolacca acinosa* showed the highest IVI (28.34) at S3 in autumn season followed by summer season (27.52) and spring season (23.34) at the S3 (Daksum site) and *Thymus linearis* recorded the lowest IVI (2.80) at S5 and (2.72) at S9. The Importance Value Index (IVI) varied significantly across seasons, with *Phytolacca acinosa* consistently emerging as the most dominant species, reflecting its ecological adaptability and competitive strength. In the spring season, *Phytolacca acinosa* recorded the highest IVI at S3 (23.34) and S2 (22.13), underscoring its prominent role in the vegetation structure at these sites. Conversely, *Thymus linearis* had the lowest IVI at S5 (2.80), indicating its minimal influence during this period (Table 2). During the summer

season, *Phytolacca acinosa* maintained its dominance, achieving the highest IVI of 27.52 at S3, followed by 20.96 at S2 and 19.71 at S1. Meanwhile, *Thymus linearis* showed the lowest IVI at S4 (2.90), suggesting limited ecological presence during summer (Table 3). In the autumn season, *Phytolacca acinosa* again recorded the highest IVI, particularly at S3 (28.34), followed by S1 (20.92) and S4 (18.67). In contrast, the lowest IVI values were reported for *Daucus carota* (2.21), *Festuca arundinacea* (3.14), and *Poa annua* (3.20) at S2, indicating these species' reduced ecological roles in autumn (Table 4).

Overall, these findings highlight *Phytolacca acinosa* as a consistently dominant species across all seasons, particularly at site S3, while other species like *Thymus linearis* and *Daucus carota* exhibited lower ecological significance. The variation in IVI underscores the influence of environmental factors and site-specific conditions on species dominance and distribution.

Table 2. Importance Value Index of herbs in spring season at the different sites of Kashmir Himalayas

S. No	Name of the species	Spring season								
		S1 NW (2771 m)	S2 SE (1872 m)	S3 NE (2992 m)	S4 NE (2624 m)	S5 SW (2128 m)	S6 NE (1774 m)	S7 NW (2173 m)	S8 SE (1851 m)	S9 NW (2652 m)
1.	<i>Achillea millefolium</i>	12.13	-	-	-	6.93	10.9	7.93	9.67	10.76
2.	<i>Agrimonia eupatoria</i>	-	9.54	-	-	10.07	-	-	-	-
3.	<i>Amaranthus caudatus</i>	13.02	8.27	-	-	7.98	10.7	4.57	8.45	10.61
4.	<i>Amaranthus viridis</i>	-	9.42	-	-	11.21	14.37	-	10.61	-
5.	<i>Arctium lappa</i>	-	-	8.23	4.67	7.04	13.56	3.65	-	6.99
6.	<i>Arnebia hispidissima</i>	-	7.70	-	-	-	6.03	10.47	11.02	-
7.	<i>Artemisia absinthium</i>	10.03	-	12.89	10.02	9.90	-	6.53	10.87	15.08
8.	<i>Asplenium species</i>	-	-	13.25	13.45	-	9.45	7.93	-	7.58
9.	<i>Bothriochloa ischaemum</i>	-	6.58	-	-	5.33	-	7.92	5.47	6.66
10.	<i>Cannabis sativa</i>	-	13.87	19.05	15.71	11.45	20.3	-	-	-
11.	<i>Capsella bursa pastoris</i>	-	8.90	-	-	8.58	14.97	-	-	9.17
12.	<i>Centaurea iberica</i>	-	-	-	9.24	5.35	11.88	-	5.11	13.3
13.	<i>Chenopodium album</i>	-	-	-	-	-	-	-	-	-
14.	<i>Cichorium intybus</i>	9.60	-	-	-	5.43	-	3.54	6.29	8.17
15.	<i>Conyza canadensis</i>	-	-	20.71	-	10.92	12.09	-	-	-
16.	<i>Cymbopogon nardus</i>	13.74	7.56	17.45	-	-	-	6.73	6.91	6.53
17.	<i>Cynodon dactylon</i>	9.87	11.61	13.51	12.12	10.32	13.98	12.64	11.40	15.84
18.	<i>Daucus carota</i>	5.20	7.94	-	16.91	-	-	13.21	12.96	13.48
19.	<i>Festuca arundinacea</i>	-	2.98	-	6.92	-	-	-	-	-
20.	<i>Festuca rubra L.</i>	-	4.02	-	-	-	4.10	9.12	6.09	7.69
21.	<i>Fragaria nubicula</i>	7.59	5.41	10.05	10.38	7.56	-	-	5.56	-
22.	<i>Fragaria vesca</i>	-	6.75	-	14.6	4.69	8.33	10.31	9.79	-

23.	<i>Lespedeza species</i>	9.34	-	10.36	10.76	-	-	-	-	12.01
24.	<i>Lolium perenne</i>	12.47	10.32	-	12.81	8.29	-	11.91	9.79	10.19
25.	<i>Malva neglecta</i>	-	7.77	-	15.4	8.18	13.11	-	5.41	12.45
26.	<i>Marrubium vulgare</i>	18.64	-	13.55	12.29	7.14	11.31	10.93	-	7.80
27.	<i>Matricaria chamomilla</i>	-	11.94	-	-	-	-	8.78	7.73	10.22
28.	<i>Medicago minima</i>	15.01	12.39	-	-	9.90	-	13.04	9.29	12.02
29.	<i>Mentha longifolia</i> Huds.	10.68	9.04	9.88	-	7.35	-	-	11.18	-
30.	<i>Mentha spicata</i> L.	-	-	-	-	6.39	-	-	-	-
31.	<i>Myosotis arvensis</i> (L.)	-	-	-	-	-	-	-	-	-
32.	<i>Nepata cataria</i> L.	9.49	-	-	-	5.60	-	-	8.04	-
33.	<i>Oxalis acetosella</i>	-	10.49	17.39	14.18	5.85	8.88	-	10.78	-
34.	<i>Oxalis corniculata</i>	6.60	9.43	14.9	14.33	5.30	7.08	12.20	10.26	-
35.	<i>Phytolacca acinosa</i>	20.12	22.14	23.34	17.04	9.62	-	14.70	-	-
36.	<i>Plantago lanceolata</i>	13.40	-	21.54	3.79	11.36	15.20	13.75	-	19.84
37.	<i>Plantago major</i>	-	13.39	12.89	8.44	7.97	-	9.14	9.29	-
38.	<i>Poa annua</i>	14.93	7.19	3.35	-	-	-	11.91	9.72	-
39.	<i>Poa bulbosa</i>	-	3.18	-	-	-	-	-	-	-
40.	<i>Poa pretense</i>	-	6.40	8.34	-	5.18	-	9.12	7.00	-
41.	<i>Polygonum heterophyllum</i>	-	-	-	-	-	3.39	-	-	-
42.	<i>Prunella vulgaris</i>	-	3.97	-	13.05	-	-	-	6.34	-
43.	<i>Ranunculus hirtellus</i>	-	-	-	-	5.27	-	-	7.13	-
44.	<i>Rumex nepalensis</i>	-	6.40	13.55	10.68	9.31	-	-	9.80	-
45.	<i>Salvia moorcroftiana</i>	-	8.44	-	12.09	11.32	-	-	10.31	-
46.	<i>Scandix pectenvenensis</i>	-	10.28	9.24	-	-	17.03	14.65	-	14.95
47.	<i>Setaria viridis</i>	-	9.87	-	-	-	-	-	-	-
48.	<i>Solanum nigrum</i>	-	12.39	11.41	12.1	10.04	-	-	-	-
49.	<i>Sorghum helpense</i>	12.90	-	-	-	6.20	8.58	11.78	7.29	6.81
50.	<i>Stipa sibirica</i>	10.22	-	15.09	-	5.97	17.21	7.93	-	10.63
51.	<i>Taraxicum officinale</i>	-	-	-	16.73	9.90	15.5	3.91	6.95	15.08
52.	<i>Thymus linearis</i> Benth.	-	-	-	-	2.80	-	-	-	-
53.	<i>Trifolium pratense</i>	15.22	-	-	-	7.03	12.92	12.40	11.90	13.03
54.	<i>Trifolium repens</i>	9.86	-	-	12.31	5.38	8.58	11.57	-	10.92
55.	<i>Urtica dioica</i>	19.03	-	-	-	5.88	-	7.89	5.73	9.12
56.	<i>Verbasicum thapus</i>	7.95	11.76	-	-	-	10.48	9.85	11.66	-
57.	<i>Viola odorata</i>	-	2.65	-	-	-	-	-	4.28	3.08

NW-North West, NE-North East, SE-South East, SW-South West, S1-Pahalgam, S2-Vastoorwan,

S3- Daksum, S4-Naranag, S5-Ganidobh, S6-Gund, S7-Tangmarg, S8-Lolab, S9-Gulmarg, (-)

Absence, (+) Presence

Table 3. Importance Value Index of herbs in summer season at the different sites of Kashmir Himalayas

S. No.	Name of the species	Summer season								
		S1	S2	S3	S4	S5	S6	S7	S8	S9

	NW (2771 m)	SE (1872 m)	NE (2992 m)	NE (2624 m)	SW (2128 m)	NE (1774 m)	NW (2173 m)	SE (185 1 m)	NW (2652 m)
1. <i>Achillea millefolium</i>	12.02	-	-	-	9.34	13.29	8.59	9.94	11.86
2. <i>Agrimonia eupatoria</i>	-	10.97	-	-	10.31	-	-	-	-
3. <i>Amaranthus caudatus</i>	13.16	11.46	-	-	10.81	13.01	7.85	8.61	12.18
4. <i>Amaranthus viridis</i>	8.33	9.99	-	-	10.96	15.08	-	13.18	-
5. <i>Arctium lappa</i>	-	-	6.93	7.21	8.53	13.03	5.79	-	6.22
6. <i>Arnebia hispidissima</i>	-	9.18	-	-	-	5.86	7.17	12.35	-
7. <i>Artemisia absinthium</i>	8.77	-	16.97	12.09	9.95	-	7.23	10.70	12.79
8. <i>Asplenium species</i>	-	-	13.82	12.19	-	8.69	7.23	-	5.15
9. <i>Bothriochloa ischaemum</i>	-	7.44	-	-	5.07	-	7.81	5.15	6.96
10. <i>Cannabis sativa</i>	-	15.32	18.72	19.13	11.39	19.58	-	-	-
11. <i>Capsella bursa pastoris</i>	-	9.18	-	-	8.33	15.48	-	-	9.42
12. <i>Centaurea iberica</i>	-	-	-	10.31	6.18	12.76	-	4.93	14.67
13. <i>Chenopodium album</i>	7.42	6.79	12.74	-	-	12.33	7.44	8.12	7.73
14. <i>Cichorium intybus</i>	11.61	-	-	-	5.22	-	3.41	6.12	7.32
15. <i>Conyza canadensis</i>	-	-	18.56	-	9.93	10.83	-	-	-
16. <i>Cymbopogon nardus</i>	11.95	6.96	16.77	-	-	-	6.48	6.74	5.88
17. <i>Cynodon dactylon</i>	10.15	10.99	11.89	12.62	9.77	12.35	10.92	10.59	13.58
18. <i>Daucus carota</i>	4.68	7.35	-	14.56	-	-	11.61	10.28	11.01
19. <i>Festuca arundinacea</i>	-	2.82	-	7.55	-	-	-	-	-
20. <i>Festuca rubra L.</i>	-	3.65	-	-	-	3.76	8.24	5.45	6.46
21. <i>Fragaria nubicula</i>	3.62	6.02	9.79	9.96	7.06	-	-	6.12	-
22. <i>Frageria vesca</i>	-	6.21	-	13.95	4.38	4.71	10.06	9.03	-
23. <i>Lespedeza species</i>	8.75	-	10.28	9.01	-	-	-	-	9.96
24. <i>Lolium perenne</i>	10.89	9.09	-	12.17	7.50	-	10.51	8.69	8.49
25. <i>Malva neglecta</i>	-	7.7	-	16.61	8.30	13.08	-	5.43	11.64
26. <i>Marrubium vulgare</i>	16.75	-	13.69	12.19	7.32	11.34	10.99	-	7.29
27. <i>Matricaria chamomilla</i>	-	11.13	-	-	-	-	8.13	7.27	8.74
28. <i>Medicago minima</i>	13.13	10.97	-	-	9.09	-	11.96	8.63	10.26
29. <i>Mentha longifolia Huds.</i>	9.20	8.09	8.97	-	6.72	-	-	10.22	-
30. <i>Mentha spicata L.</i>	-	-	-	-	5.64	-	-	-	-
31. <i>Myosotis arvensis (L.)</i>	-	-	-	-	-	-	3.20	-	5.78
32. <i>Nepata cataria L.</i>	9.59	-	-	-	4.99	-	-	7.09	-
33. <i>Oxalis acetosella</i>	-	9.39	14.42	12.62	5.37	7.57	-	9.80	-
34. <i>Oxalis corniculata</i>	7.40	8.93	12.34	14.41	4.92	6.75	10.51	9.43	-
35. <i>Phytolacca acinosa</i>	19.71	20.96	27.52	15.68	9.27	-	13.83	-	-
36. <i>Plantago lanceolata</i>	13.99	-	20.63	9	12.16	11.95	13.16	-	17.49
37. <i>Plantago major</i>	-	12.11	11.93	9.13	7.42	-	7.23	8.71	-
38. <i>Poa annua</i>	13.58	6.61	5.70	-	-	-	11.06	9.11	-
39. <i>Poa bulbosa</i>	-	2.91	-	-	-	-	-	-	-
40. <i>Poa pretense</i>	-	5.68	7.40	-	5.31	-	8.15	6.17	-
41. <i>Polygonum heterophyllum</i>	-	-	-	-	-	4.41	-	-	-
42. <i>Prunella vulgaris</i>	-	3.47	-	11.13	-	-	-	5.66	-
43. <i>Ranunculus hirtellus</i>	-	-	-	-	4.89	-	-	6.55	-
44. <i>Rumex nepalensis</i>	-	7.95	12.33	9.38	9.43	-	-	8.94	-
45. <i>Salvia moorcroftiana</i>	-	7.27	-	10.07	9.70	-	-	8.79	-
46. <i>Scandix pectenvenaris</i>	-	8.73	5.78	-	-	14.53	12.34	-	13.21
47. <i>Setaria viridis</i>	-	9.01	-	-	-	-	-	-	-

48.	<i>Solanum nigrum</i>	-	10.97	8.56	10.49	9.09	-	-	-	-
49.	<i>Sorghum helpense</i>	12.07	-	-	-	5.82	9.14	12.56	6.81	9.42
50.	<i>Stipa sibirica</i>	10.62	-	14.28	-	5.73	16.26	7.51	-	12.09
51.	<i>Taraxicum officinale</i>	13.99	-	-	14.4	9.57	13.79	3.45	8.33	12.26
52.	<i>Thymus linearis Benth.</i>	-	-	-	2.90	3.56	-	-	-	3.57
53.	<i>Trifolium pratense</i>	14.37	-	-	-	7.51	13.07	11.75	12.29	11.48
54.	<i>Trifolium repens</i>	12.07	-	-	11.24	6.88	9.23	10.99	-	10.63
55.	<i>Urtica dioica</i>	15.85	-	-	-	6.6	-	7.18	7.82	11.07
56.	<i>Verbascum thapus</i>	6.33	11.27	-	-	-	8.14	9.43	11.36	-
57.	<i>Viola odorata</i>	-	3.42	-	-	-	-	6.20	5.57	5.28

NW-North West, NE-North East, SE-South East, SW-South West, S1-Pahalgam, S2-Vastoorwan,

S3- Daksum, S4-Naranag, S5-Ganidobh, S6-Gund, S7-Tangmarg, S8-Lolab, S9-Gulmarg, (-)

Absence, (+) Presence

Table 4. Importance Value Index of herbs in autumn season at the different sites of Kashmir Himalayas

S. No.	Name of the species	Autumn season								
		S1 NW (2771 m)	S2 SE (1872 m)	S3 NE (2992 m)	S4 NE (2624 m)	S5 SW (2128 m)	S6 NE (1774 m)	S7 NW (2173 m)	S8 SE (1851 m)	S9 NW (2652 m)
1.	<i>Achillea millefolium</i>	12.07	7.57	-	-	7.28	11.57	6.63	7.33	9.30
2.	<i>Agrimonia eupatoria</i>	-	9.65	-	-	10.12	-	-	-	-
3.	<i>Amaranthus caudatus</i>	11.07	9.02	-	-	9.55	12.63	5.28	9.60	9.99
4.	<i>Amaranthus viridis</i>	6.43	-	-	-	10.44	17.40	-	11.25	-
5.	<i>Arctium lappa</i>	-	8.34	5.51	5.13	7.70	12.06	3.81	-	7.48
6.	<i>Arnebia hispidissima</i>	-	-	-	-	-	4.83	9.08	11.56	-
7.	<i>Artemisia absinthium</i>	8.45	-	11.42	10.52	9.12	-	5.14	10.72	13.25
8.	<i>Asplenium species</i>	-	6.00	13.46	10.58	-	9.74	7.84	-	6.15
9.	<i>Bothriochloa ischaemum</i>	-	17.1	-	-	4.91	-	8.33	5.67	6.05
10.	<i>Cannabis sativa</i>	-	9.11	14.98	18.02	11.15	19.98	-	-	-
11.	<i>Capsella bursa pastoris</i>	-	-	-	-	9.24	14.79	-	-	8.23
12.	<i>Centaurea iberica</i>	-	4.55	-	9.95	5.69	10.89	-	5.51	11.9
13.	<i>Chenopodium album</i>	6.46	-	7.22	-	-	9.86	9.94	7.39	9.44
14.	<i>Cichorium intybus</i>	11.12	-	-	-	5.78	-	3.69	6.78	8.64
15.	<i>Conyza canadensis</i>	-	7.71	16.61	-	9.94	12.30	-	-	-
16.	<i>Cymbopogon nardus</i>	12.29	10.37	17.22	-	-	-	6.99	7.47	5.53
17.	<i>Cynodon dactylon</i>	10.19	7.05	13.11	11.99	9.34	12.55	11.82	10.86	11.41
18.	<i>Daucus carota</i>	3.52	2.21	-	13.1	-	-	12.62	11.41	11.26
19.	<i>Festuca arundinacea</i>	-	3.14	-	5.72	-	-	-	-	-
20.	<i>Festuca rubra L.</i>	-	4.58	-	-	-	2.94	8.82	6.02	7.77
21.	<i>Fragaria nubicula</i>	8.03	5.8	9.15	10.06	5.78	-	-	5.69	-

22.	<i>Fragaria vesca</i>	-	-	-	13.15	3.92	7.7	10.87	8.94	-
23.	<i>Lespedeza species</i>	7.36	8.31	9.97	9.13	-	-	-	-	10.46
24.	<i>Lolium perenne</i>	9.9	8.55	-	12.89	7.56	-	11.36	8.75	7.3
25.	<i>Malva neglecta</i>	-	-	-	17.79	8.2	13.08	-	6.00	12.19
26.	<i>Marrubium vulgare</i>	17.65	12.34	15.28	14.41	8.17	11.03	11.93	-	8.61
27.	<i>Matricaria chamomilla</i>	-	12.16	-	-	-	-	8.85	8.08	8.51
28.	<i>Medicago minima</i>	13.53	8.99	-	-	9.12	-	13.00	9.54	12.07
29.	<i>Mentha longifolia Huds.</i>	10.75	-	9.99	-	7.49	-	-	10.06	-
30.	<i>Mentha spicata L.</i>	-	-	-	-	6.25	-	-	-	-
31.	<i>Myosotis arvensis (L.)</i>	-	-	-	-	-	-	5.81	-	2.72
32.	<i>Nepata cataria L.</i>	9.22	10.37	-	-	5.52	-	-	7.88	-
33.	<i>Oxalis acetosella</i>	-	9.84	16.09	11.99	5.95	8.39	-	9.96	-
34.	<i>Oxalis corniculata</i>	7.39	21.56	13.65	13.97	5.43	7.40	11.37	8.51	-
35.	<i>Phytolacca acinosa</i>	20.92	-	28.34	18.67	10.41	-	15.14	-	-
36.	<i>Plantago lanceolata</i>	14.05	13.46	23.44	6.45	12.31	13.64	14.37	-	18.90
37.	<i>Plantago major</i>	-	7.31	13.47	8.87	8.2	-	7.84	9.63	-
38.	<i>Poa annua</i>	13.05	3.20	4.90	-	-	-	10.96	9.17	-
39.	<i>Poa bulbosa</i>	-	6.25	-	-	-	-	-	-	-
40.	<i>Poa pretense</i>	-	-	8.13	-	5.13	-	7.74	6.83	-
41.	<i>Polygonum heterophyllum</i>	-	3.84	-	-	-	3.33	-	-	-
42.	<i>Prunella vulgaris</i>	-	-	-	9.26	-	-	-	4.98	-
43.	<i>Ranunculus hirtellus</i>	-	7.60	-	-	5.40	-	-	7.26	-
44.	<i>Rumex nepalensis</i>	-	8.05	13.93	10.98	9.45	-	-	9.89	-
45.	<i>Salvia moorcroftiana</i>	-	9.71	-	11.81	10.81	-	-	9.81	-
46.	<i>Scandix pectenvenenis</i>	-	8.95	10.71	-	-	16.39	11.83	-	15.71
47.	<i>Setaria viridis</i>	-	12.16	-	-	-	-	-	-	-
48.	<i>Solanum nigrum</i>	-	-	9.50	12.35	10.11	-	-	-	-
49.	<i>Sorghum helpense</i>	13.94	-	-	-	6.46	8.91	10.64	7.56	9.57
50.	<i>Stipa sibirica</i>	10.65	-	13.89	-	6.36	16.81	8.15	-	12.65
51.	<i>Taraxicum officinale</i>	16.34	-	-	16.89	9.72	12.56	3.73	6.88	13.08
52.	<i>Thymus linearis Benth.</i>	-	-	-	3.3	2.84	-	-	-	2.81
53.	<i>Trifolium pratense</i>	13.79	-	-	-	7.45	13.29	10.52	10.69	13.57
54.	<i>Trifolium repens</i>	10.89	-	-	13.02	5.65	8.99	9.60	-	11.15
55.	<i>Urtica dioica</i>	16.37	12.6	-	-	6.05	-	7.79	5.92	11.18
56.	<i>Verbasicum thapus</i>	4.56	2.55	-	-	-	6.93	5.87	12.72	-
57.	<i>Viola odorata</i>	-	-	-	-	-	-	2.65	3.70	3.07

NW-North West, NE-North East, SE-South East, SW-South West, S1-Pahalgam, S2-Vastoorwan,

S3- Daksum, S4-Naranag, S5-Ganidobh, S6-Gund, S7-Tangmarg, S8-Lolab, S9-Gulmarg, (-)

Absence, (+) Presence

The distribution of plant populations in a given area is shaped by an interplay of biological and physical factors. Key physiographic features such as slope, aspect, parent material and soil properties are crucial in defining vegetation patterns across different landscapes (Barnes *et al.*, 1997). Each

species has specific resource needs or tolerances, enabling some to outcompete others in certain environments (Glatzel, 2009). Evidence suggests that understorey vegetation tends to proliferate during the early stages of succession when open conditions favor species invasion (Goirala *et al.*, 2008). Opportunistic species, which are highly light-dependent, quickly occupy gaps in vegetation. Their establishment is facilitated by increased light, water availability and accelerated organic matter decomposition, all of which provide essential resources for herbaceous species to thrive. As gaps expand, additional resources become accessible, further supporting the growth of these plants.

In forest ecosystems, resource distribution is often spatially heterogeneous, creating multiple niches even within small areas due to significant variations in resource availability (Balandier *et al.*, 2006). Seasonal resource fluctuations further contribute to competitive dynamics, where no single species can dominate consistently under changing conditions (Lambers *et al.*, 1998; Grime, 2001). The high species density observed during spring and summer is likely linked to increased moisture availability from rainfall and other environmental factors. Similar patterns have been documented in previous studies (Hussain *et al.*, 2019; Sharma and Upadhyay (2002); Baba *et al.*, 2017). Additionally, Alhassan *et al.*, (2006) identified climatic variables as significant contributors to variations in species diversity and abundance.

The reduction in understorey vegetation can be attributed to differences in overstorey tree species and their densities, which alter microclimatic conditions (Anderson *et al.*, 1968; Alaback and Herman, 1988; Thomas *et al.*, 1999). Furthermore, changes in environmental factors such as altitude, aspect and litter accumulation on the soil surface regulated by the balance between litter production and decomposition affect microhabitats (Berg and Staaf, 1981; Staelens *et al.*, 2003). Studies by Tasveer (2022), Rizwi (2021) and Hussain *et al.*, (2019) also report similar patterns of herbaceous vegetation, highlighting consistent findings across different regions.

3. CONCLUSION

The present study conducted in the Kashmir valley at 4 different aspects (Northwest, Northeast, Southeast and Southwest aspect) reveals floristic

composition and seasonal variation of 57 reported herbs across the study sites. The density of herbs was recorded highest in summer season of Ganidobh (S5) site at southwest aspect and lowest in autumn season at Northeast aspect of Daksum (S3) site. The highest Importance Value Index (IVI) in spring season for *Phytolacca acinosa* occurs at S3 and S2 with values of 23.34 and 22.13 respectively and lowest by *Thymus linearis* (2.80) at S5. In summer season, the highest IVI for *Phytolacca acinosa* is recorded at S3 (NE) with 27.52 followed by S2 (20.96) and S1 (19.71) and *Thymus linearis* lowest IVI (2.90) at S4. The highest IVI in autumn season at study sites for *Phytolacca acinosa* with value (28.34) at S3 followed by S1 (20.92) and S4 with IVI (18.67) and the lowest was reported for *Daucus carota*, *Festuca arundinacea* and *Poa annua* at S2 with respective IVI values (2.21, 3.14 and 3.20).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have not been used during the writing or editing of this manuscript.

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