# ROLE OF MULTIVARIATE APPROACHES IN FLORISTIC DIVERSITY OF MANOOR VALLEY (HIMALAYAN REGION), PAKISTAN

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**Abstract.** The main source of botanical information of a particular area is its floristic checklists. Floristic study of any given area helps to evaluate the plant wealth and its potential values. To assess floristic diversity of an unexplored remote valley (Manoor Valley), frequent field visits were arranged in different growing seasons during 2015 to 2018. The life form classes and leaf spectra of all plant species were determined and further classified according to the Raunkiaer classification. Plant species were identified and deposited to the Herbarium at Hazara University, Mansehra. The floristic diversity consisted of 354 plant species belonging to 93 families. Herbaceous was the most representative growth form, with 259 species, followed by shrubs with 52 species, trees with 42 species and parasitic plant with one species. Asteraceae was the leading family with 36 species, followed by Lamiaceae species. Furthermore, results indicated the dominancy of Therophytic plants and Nanophyllous and Microphyllous leaves. July marked the peak of flowering period and September the peak of fruiting period. This study provided the first insight of the floristic inventory in relation to multivariate approaches in this unexplored area. This regional novel launched list may serve as a vital resource for all future endeavors in the field of phytosociological, pharmacological and conservational studies of natural resources.
**Keywords:** *floristic checklist, Asteraceae, principal components analysis, species response curve*

## Introduction

Vegetation is an umbrella term that indicates plant life of a region (Rahman et al., 2018a) or, in other words, a group of plants growing together in a particular area and may be characterized by its component species (Malik, 1990). Flora is a priceless donation of nature upon which the mankind always relies (Khan et al., 2013). Flora


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comprises the total plant species of any specific geographic region, which are characteristic of a geological period or in habit a particular ecosystem (Durrani et al., 2005). According to the report of Walter and Hamiston (1993), approximately 422,000 flowering plants have been reported globally (Rahman et al., 2016a). Pakistan is blessed with diverse flora due to variability in climate (Rahman et al., 2018b) and presents about 6000 flowering plant species (Rahman et al., 2016a).

The main source of botanical information of a particular area is its floristic checklists (Safidkon et al., 2003). Floristic study of any given area helps to evaluate the plant wealth and its potential values (Shaheen et al., 2016). Local plant species documentation is very necessary to introduce specific floral species of the local area, their occurrence and finding new species (Ali, 2008). Many workers have contributed comprehensive floristic checklists of local flora in different regions (Qureshi, and Bhatti, 2008; Jabeen et al., 2009; Shaheen et al., 2011).

In these studies of floristic checklist, besides evaluating the species richness, it is also necessary to observe the plant life form, leaf size and phenology over the year (Rahman et al., 2018a). Life form is the indicator of micro and macroclimate and it is characterized by plant adaptation to certain ecological conditions (Shimwell, 1971). As the plants arranged by the Raunkiaer (1934) in order to form classes on the basis of their life form, five major classes were formed (Hussain and Perveen, 2009) which includes: Phanerophytes, Hemicryptophytes, Cryptophytes, Chamaephytes, and Therophytes. Plants are also classified on the basis of leaf sizes and this has been exceptionally helpful for association mapping of vegetation. The leaf size knowledge helps in understanding physiological processes of plants (Oosting, 1956). For instance, biotic agencies are the chief causes for changing the biological spectrum in a given floristic zone (Amjad, 2012).

Phenology demonstrates the relationship of plant development to seasonal variations as well as photoperiod to program their developmental stages and natural exercises appropriated with the normal seasonal conditions (Manske, 2006). Essentially, timings and interim of the intermittent natural occasions (biological events) among stages of plant species give a foundation of gathering and synthesizing quantitative data of plant communities, which are directly linked with phenology (Singh and Singh, 1992). There is a synchronization of phenological behavior of the plant species and the various elements of the environmental conditions that plants are discussed, the organic tickers (biological clocks). These are habitually controlled by external environmental stimuli (Zhang et al., 2006, Vilela et al., 2017). Leaf growth, leaf fall, flowering and fruiting of species occur in specific seasons of the year and the phenology of life forms varies and is associated with day length/ temperature (Rahman et al., 2018a). As reported by Ahmed (2017), the blossoming and fruiting could be connected with the climatic conditions for posterity survival. Cornejo-Tenoria and Ibarra-Manriquez (2007) recorded blossoming and fruiting behavior on month-to-month premise. Bhat and Muralli (2001) depicted the climatic factors, for example, precipitation, water accessibility, change in day length and temperature additionally triggers the phonological occasions and because of temperature contrast, there is huge variety among species in various climatic zones.

In this way, the unexplored remote valley Manoor Valley, Pakistan, has great potential for flourishing a rich plant biodiversity due to the presence of diverse microhabitats and topographic features. Since biodiversity is greatly affected by different environmental factors (Khan, 2012) and is facing serious challenges due to


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anthropogenic activities like deforestation and over grazing (Ijaz, 2014), it is fundamental to develop floristic checklist studies. Hence, the current study was designed to explore the biodiversity and document the floristic checklist of Manoor Valley. This study provides the updated insights into the floristic diversity of the area and it might also be very helpful for the future plant ecological, conservational and ecophysiological studies.

## Materials and methods

### *Study area (Manoor Valley)*

There are two sub-valleys in Kaghan Valley, i.e. Naran Valley and Manoor Valley. Naran Valley is located in upper Kaghan Valley, while Manoor Valley is reached from the main Kaghan Valley road at the junction 'Mahandri' (*Fig. 1*) and is about 50 Km north of Balakot (Rahman et al., 2016a, b). Floristically, the valley is very rich, diverse and unexplored. To date, very few references are available on floral studies of the area including few reports of medicinal studies (Rahman et al., 2016a, b, c; 2018c) and preliminary checklist (Rahman et al., 2018a).

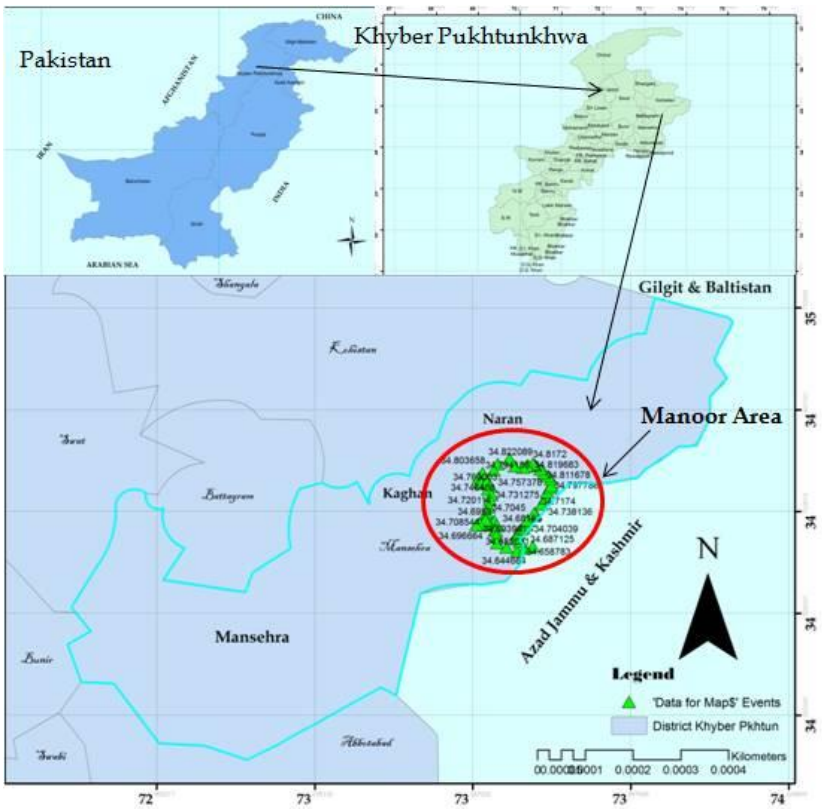


***Figure 1.*** *Map of Mansehra area showing the Manoor Valley, Pakistan*

### *Field work, equipments, identification and preservation*

From 2015 to 2018, field surveys were conducted to cover the understory area for collection of data regarding plant species. For this purpose, the study area was divided into 133 sampling sites or stations, where they were classified into life form and leaf


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sizes classes following Raunkiær (1934); Oosting (1956); Hussain (1989). Field notebook, pen, pencil, polythene bags, tags, trowel, scissors, camera, newspaper, plants presser and twig cutter were used during survey (Ijaz, 2014). The collected plants were properly dried and pressed by using newspaper for about 2-4 weeks at normal temperature. Then plants were treated or poisoned with chemical solution for preservation and mounted on standard herbarium sheets. Then data were shifted from field notebook on herbarium label of standard herbarium sheets. This herbarium label was pasted on right side of herbarium sheets (Ijaz, 2014; Ahmed, 2017). The size of herbarium sheet was standardized (11.5 x 16.5) (Ijaz, 2014). The specimens were identified by using the Flora of Pakistan (Nasir and Ali, 1971-1989; Ali and Nasir, 1989-1991; Ali and Qaiser, 1995-2017) and the identified specimens were deposited in the Herbarium of Hazara University, Mansehra, Pakistan (HUP).

### *Multivariate approaches*

Recorded plant species data was analyzed through various multivariate approaches by using different statistical packages. CANOCO 5 version was used (Rokaya et al., 2012) for multivariate ordination analyses like 'dominance curve' (DC), 'principal components analysis' (PCA) (Rokaya et al., 2012, 1992) and species response curve (SRC). PCA was determined to examine the correlation between 354 plant species and 4 growth form categories. PC-ORD 5 was used for correlation and regression coefficient (Rahman et al., 2018c). The correlation and regression coefficient evaluates the variables behavior on different axes. Chord Diagram was made through R software using package 'circlize' (Gu et al., 2014).

## Results

### *Floristic diversity*

Flora of the study area consisted of 354 plant species belonging to 93 families. In this total, the leading plant habit was herbaceous having 259 spp., followed by shrubs with 52 spp., trees with 42 spp., and parasitic plant with one species, respectively (*Fig. 2*). Asteraceae was the leading families with 36 species, followed by Lamiaceae with 24 species, Rosaceae with 22 species. For a complete inventory see *Appendix*.

Based on biological spectrum, the flora was dominated by Therophytes (116 spp.) followed by Hemicryptophytes (90 spp.), Nanophanerophytes (48 spp.) and Chamaephytes (29 spp.) (*Fig. 3*). On the basis of leaf spectra, the study area was dominated by Nanophyll and Microphyll with 105 spp. and 100 spp., respectively, followed by Mesophyll (64 spp.), Leptophyll (58 spp.), and Megaphyll (23 spp.) (*Fig. 4*). Further, four species (*Cuscuta reflexa, Ephedra girardiana, Equisetum arvense* and *Periploca aphylla*) were found as Aphyllous. For a complete inventory of biological spectrum and leaf size see *Appendix*.

The flowering data showed that July marked the peak of flowering season where 90 plant species had flowers, followed by June with 80 species. In May, flowering was observed in 68 species, followed by April with 42 species. The fruiting data showed that September was the peak fruiting season for 82 plant species, followed by August for 79 species.


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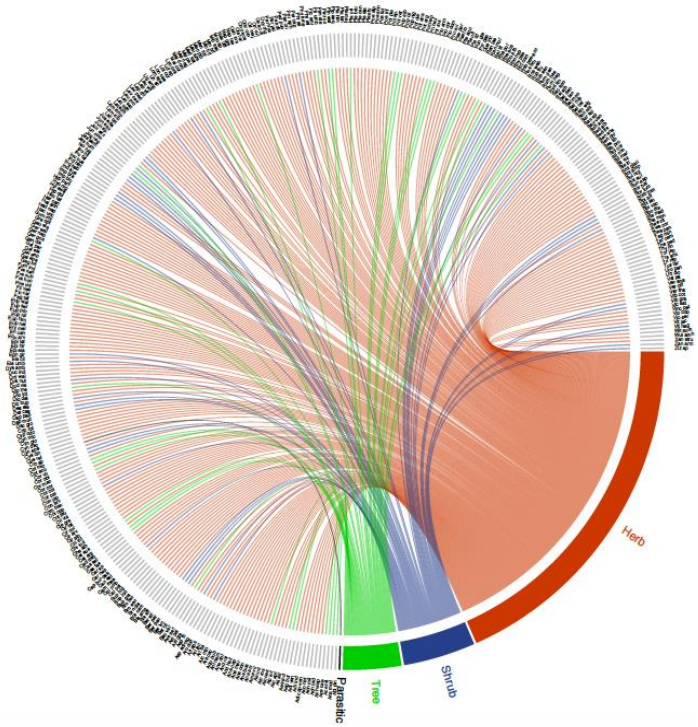


***Figure 2.*** *Distribution of the 354 species found in Manoor Valley, Pakistan, among the growth plant habit: herb (red), shrub (blue), tree (green) and parasitic plant (black). Herbs are represented by 259 species, shrubs by 52 species, trees by 42 species and parasitic plants by 1 species. The full name of species is in Appendix*

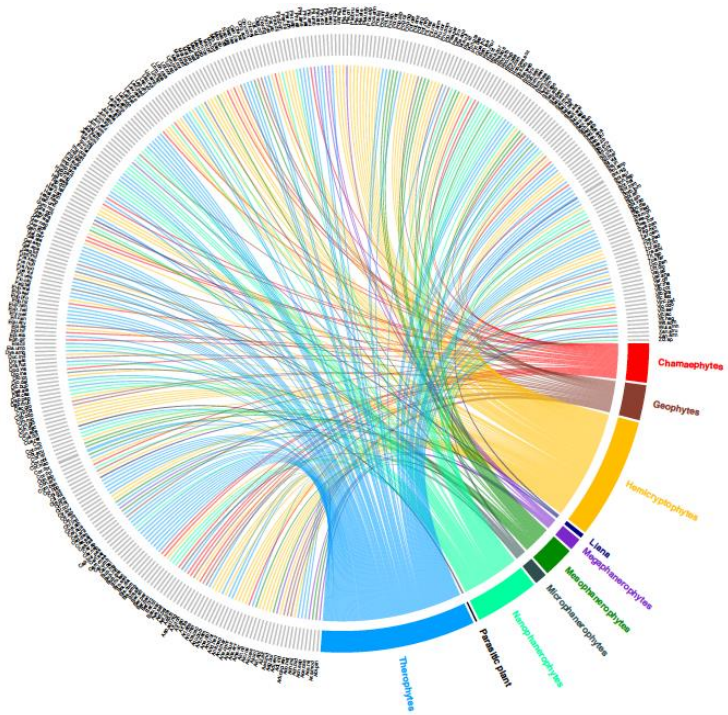


***Figure 3.*** *Distribution of the 354 species found in Manoor Valley, Pakistan, among the life form classes. The full name of species is in Appendix*


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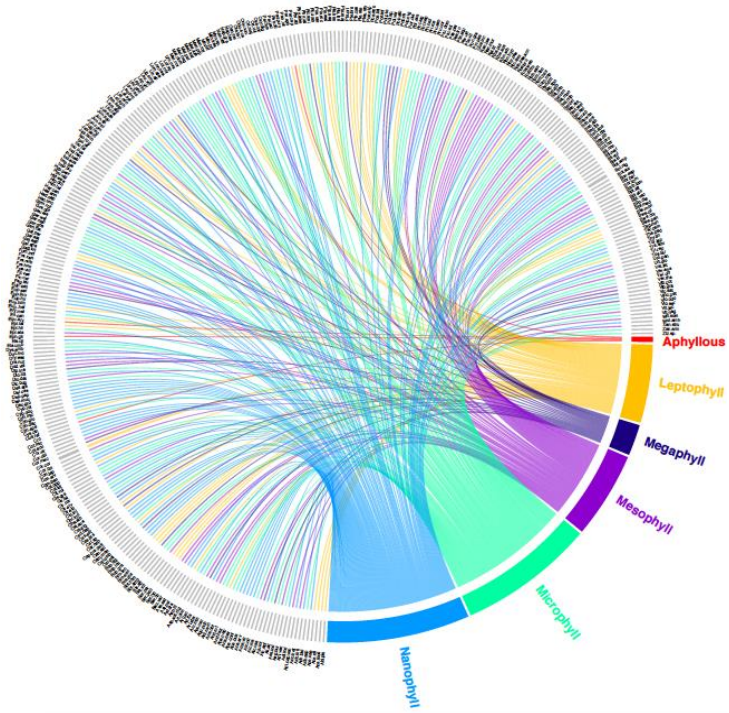


***Figure 4.*** *Distribution of the 354 species found in Manoor Valley, Pakistan, among the leaf size classes. The full name of species is in Appendix*

### *Correlation and regression coefficient*

The correlation and regression coefficient variables behaved differently on different axes. On axis 1, highly positive correlation (1.000) and highest positive tau value (0.957) was recorded for herbaceous plant habit, while on axis 2, positive correlation value was recorded (0.24) but negative tau value (-0.095) was logged for herbaceous growth form in comparison with all other growth forms (*Fig. 5A*). Moreover, on axis 1, highly negative correlation (-0.705) and highly negative tau value (-0.766) was recorded for shrubby plant habit, while on axis 2, highly positive correlation value (0.706) and highest positive tau value (0.766) was logged (*Fig. 5B*).

The correlation and regression results of tree growth form showed negative correlation (-0.586) and positive tau value (-0.464) on axis 1 and highly negative correlation value (-0.807) and highest negative tau value (-0.696) was logged on axis 2 (*Fig. 5C*). Further, the parasitic growth form on axis 1 showed minimum negative correlation (-0.74) and minimum negative tau value (-0.055) and similarly, minimum negative correlation value (-0.014) and minimum positive tau value (-0.089) was logged on axis 2 in comparison with all other growth forms (*Fig. 5D*). Axis 1 was dominated by herbaceous growth form, while axis 2 by shrubby plant habit (*Fig. 5A-D*).

### *Principle components analysis (PCA)*

The PCA results revealed that 259 plant species were most frequently cited positively and significantly correlated with herbaceous growth form (*Fig. 6*). Fifty-two plant species indicates positive influence towards the direction of shrubby growth form. Tree growth habit was most frequently cited and positively correlated with 40 plant


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species. *Cuscuta reflexa* was the only species assigned to parasitic growth form category (*Fig. 6*).

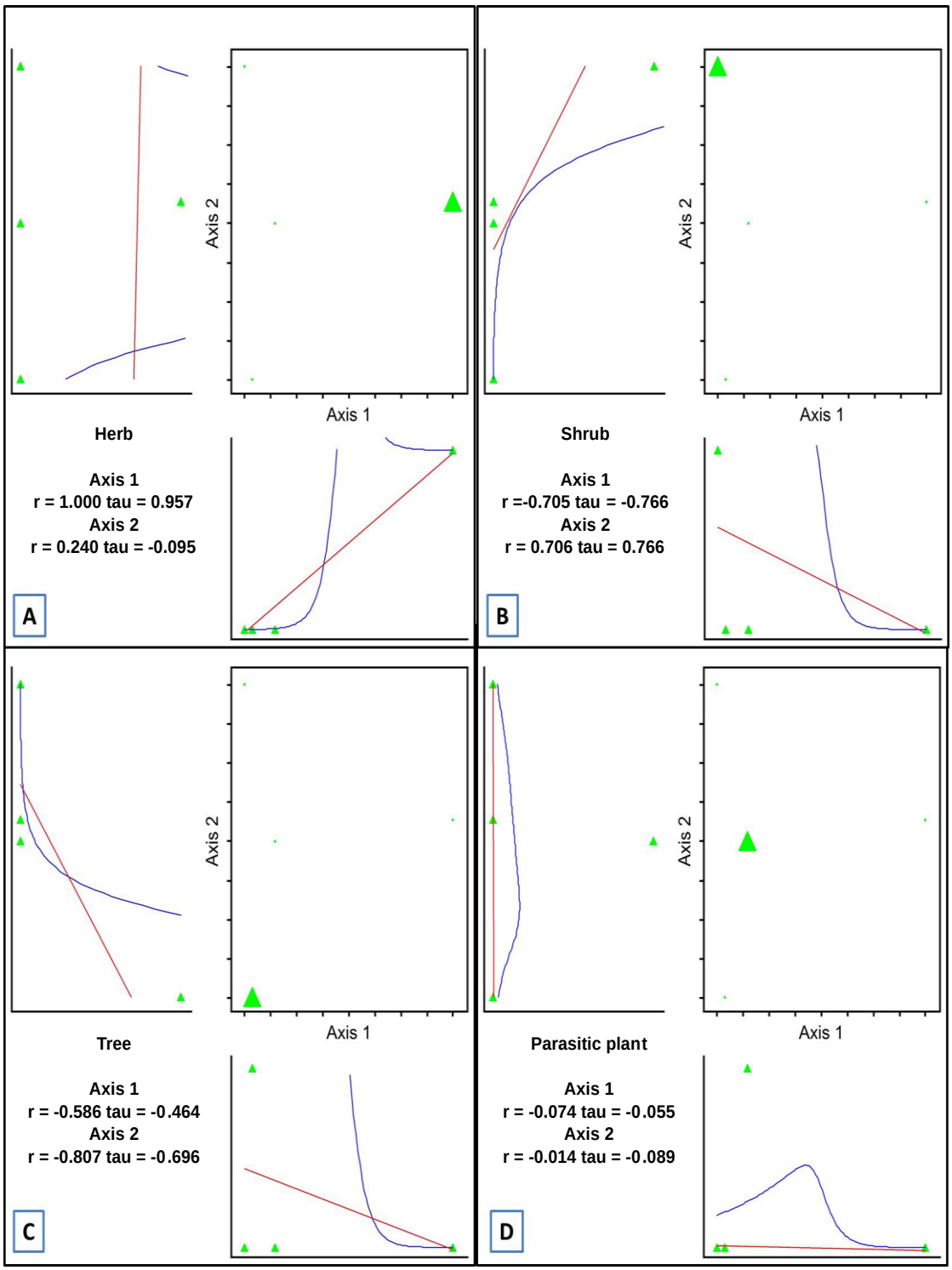


***Figure 5.*** *Correlation and regression coefficient of growth form on different axis: A) Herb, B) Shrub, C) Tree and D) Parasitic plant*


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### *Species response curve (SRC)*

The analysis clearly indicates highly significant differences (F = 451, p < 0.00001; *Fig. 7*) for herb category in comparison with all other growth form categories due to maximum number of species (*Fig. 7A*). This growth form category also revealed highest response (99.3%). Nonetheless, shrub growth form also showed highly significance (F = 415, p < 0.00001) due to its number of species in comparison with tree and parasitic plant habit and presented a response percentage of 55.1%. Also tree growth form presented significant differences (F = 142, p < 0.00001) and response percentage (29.6%) in comparison with parasitic plant habit category. Parasitic plant showed non-significant differences (F = 0.81, p = 0.63206) and response percentage (0.2%) as given in the *Table 1*. Additionally, *Figure 7B* illustrates the flow of species cited within each growth form category from top to bottom as enlisted in *Table 1*.

***Table 1.*** *Summary of fitted generalized linear models four response variables*

| Response | Type | $R^2$[%] | F | p |
|---|---|---|---|---|
| Herb | linear | 99.3 | 451 | <0.00001 |
| Shrub | linear | 55.1 | 415 | <0.00001 |
| Tree | linear | 29.6 | 142 | <0.00001 |
| Parasitic plant | linear | 0.2 | 0.81 | 0.63347 |

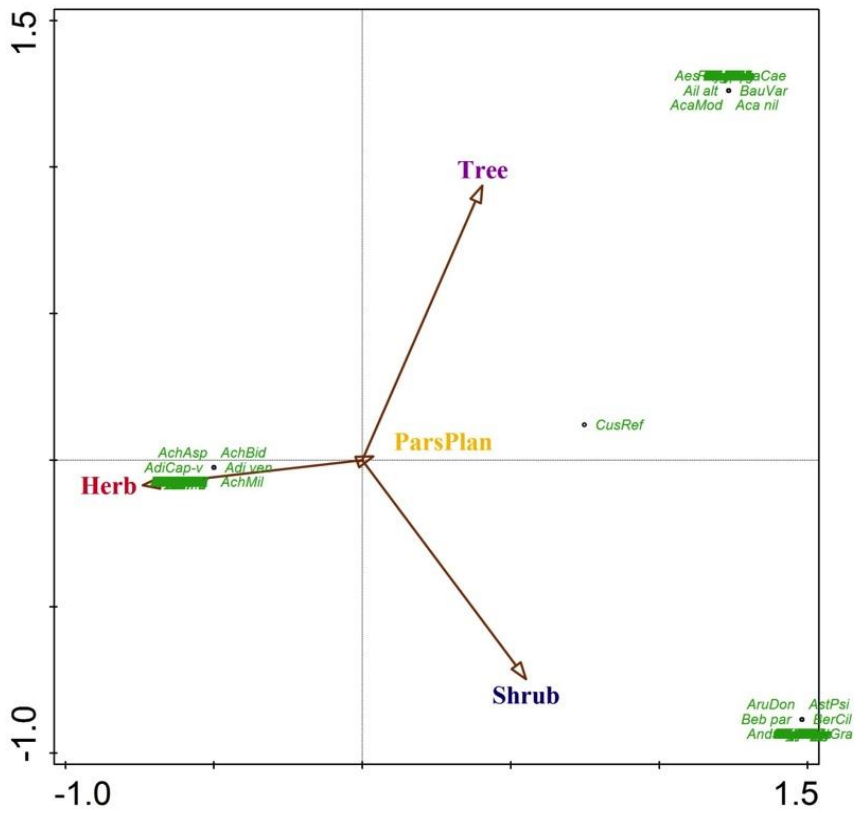


***Figure 6.*** *Principle component analysis indicating the association of plant species with their growth forms*


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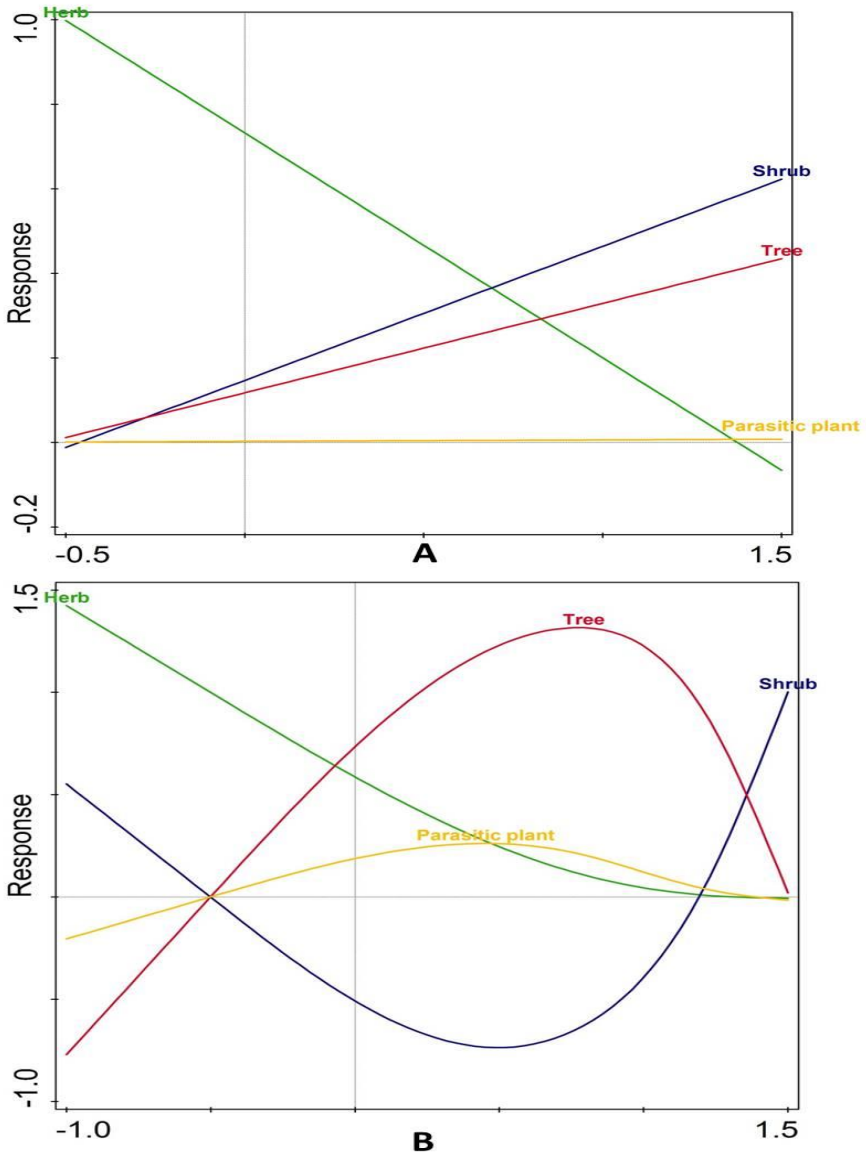


***Figure 7.*** *A) Growth form categories response curve illustrating the significance level and B) flow of species cited within each growth form category*

## Discussion

The results of this study showed that Manoor Valley, Pakistan, it is an area rich in plant species, presenting 354 species, being the herb habit most representative. Furthermore, it can be observed that the multivariate approaches showed significant differences, which supports the prediction and assertion that the herb habit is the principal plant habitat in this area.

Floristic structure is the main reflection of vegetation of any area (Rahman et al., 2018a). Plant species has its own ecological amplitude and interaction with its environment and also with other species (Giustiet al., 1995). The flora of Pakistan is diverse due to different ecological zones, diverse climatic and soil condition. In the present study, flora consisted of 354 species, where the dominating growth form was


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herbaceous with 259 species. In Pakistan, many researchers from different areas also mentioned herbaceous growth form as the leading one from their study areas (Ijaz et al., 2015; Khan et al., 2015a; Ijaz et al., 2016), which shows a predominance of herbaceous growth form in Pakistan.

Asteraceae was the leading familly with 36 species, followed by Lamiaceae with 24 species and Rosaceae with 22 species. Due to wide ecological amplitude, Asteraceae family are very diverse in habitat (Badshah et al., 2013). Khattak et al. (2015) found similar results in Karak, Pakistan and in addition Iqbal et al. (2015) also reported Asteraceae as the most predominant group in Malakand, Pakistan. On the other hand, Khan et al. (2015b) showed in a study made in Kabal (Swat), Pakistan, that Lamiaceae was the dominant family. Regardless of the family, Asteraceae and Lamiaceae appear to be the main plant families present in Pakistan's vegetation.

The flora of Manoor Valley was dominated by Therophytes, followed by Hemicryptophytes. Similarly, Badshah et al. (2013) observed Therophytes as the leading life form in Tank region, Pakistan. For various physiological processes of plants and plant communities leaf size plays a vital role (Oosting, 1956). On the basis of leaf spectra, Nanophyll and Microphyll were the most representatives. The species with Microphyllous leaves are rich due to ecological variation, which shows the percentage of different leaf form classes varied with rising altitudes and according to Cain and Castro (1959) Microphyllous species are the indication of steeps. Similar findings were observed by Saxina et al. (1987) who stated that the percentage of Microphyllous species was completely associated with the rising altitude.

Results showed that July had the flowering peak with 80 plant species, followed by June with 77 species (*Fig. 8*). These results are in agreement with those of Shrestha et al. (1998), where the authors noticed the blooming period from May to August in Kavrepalanchok, Nepal. As indicated by Marques et al. (2004), phenological period and atmosphere are associated with each other in terms of temperature, day length and precipitation or rainfall. Fruiting phase had peak in September and August (*Fig. 9*). Similar phenological scenario was reported by Morellato (1995) who reported that the blooming period begins toward the end of the dry season and at the starting of the wet season, thus fruiting takes place in dry season and that the next rainy period will offer appropriate conditions for seed germination (Morellato et al., 1989).

## Conclusion

The present study indicated that the study area has rich plant biodiversity. Flora of Manoor Valley area consisted of 354 plant species, where the leading plant habit was herbaceous with 249 species and family was Asteraceae with 36 species. We can use these inventory lists as a vital resource for all future endeavors in the field of phytosociological, phytochemical, pharmacological and conservational studies of natural resources. Regarding the multivariate approaches, we can observe that these analyzes are extremely useful to show us significant differences in certain floristic survey studies, providing support and veracity in the discussions and conclusions found. Studies like this present are necessary to evaluate the plant richness and its potential value.


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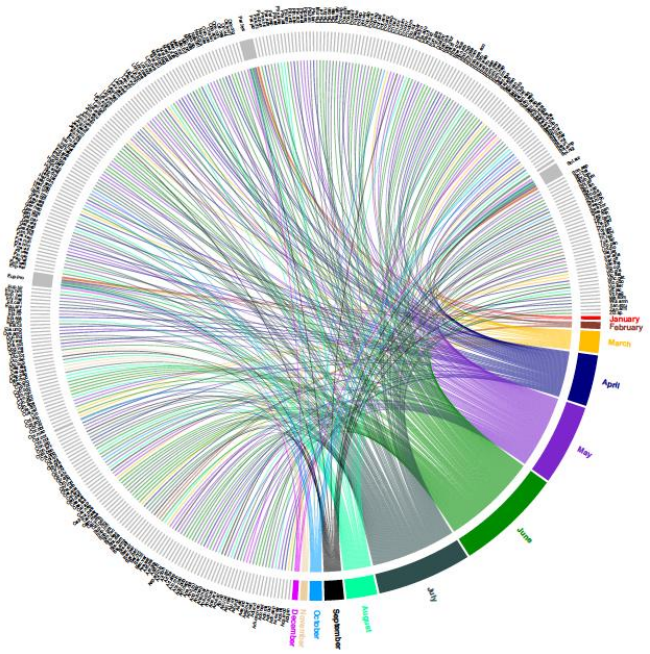


***Figure 8.*** *Distribution of the 354 species found in Manoor Valley, Pakistan, according to flowering period. The full name of species is in Appendix*

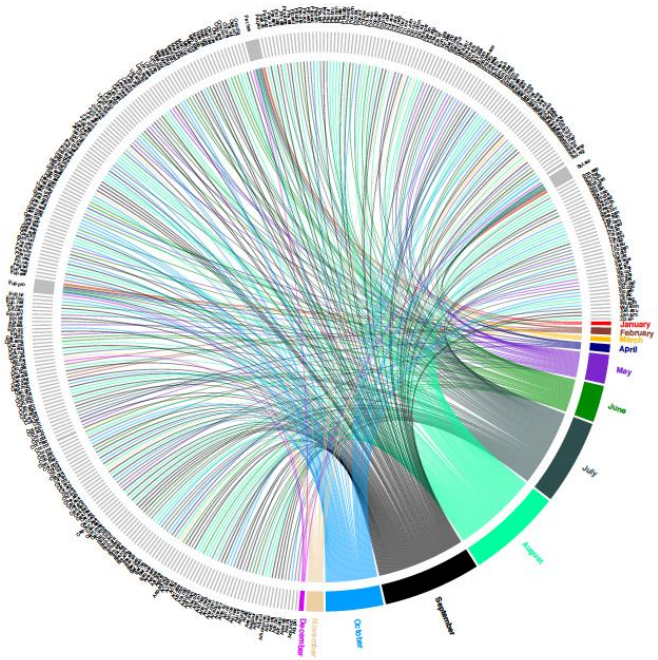


***Figure 9.*** *Distribution of the 354 species found in Manoor Valley, Pakistan, according to fruiting period. The full name of species is in Appendix*

**Author's Contributions.** IUR conducted the fieldwork, collected data and plant species, and designed the map, FI helped in the herbarium work. IUR drafted the manuscript and ESC helped in analysis of the data, NA helped in organizing the data. AA and ZI supervised the work. EFA, AA and ZI critically reviewed the manuscript. IUR, ESC, EFA and NA revised the manuscript, AAA, MSA, RK, MS and MI helped in revision. All the authors have read and approved the final manuscript.


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## REFERENCES

[1] Ahmed, J. (2017): Floristic diversity and ethnobotanical appraisal of Tehsil Oghi, District Mansehra, Pakistan. – M.Sc. Thesis (Botany), Govt. Post Graduate College, Mansehra, Pakistan.
[2] Ali, S. I. (2008): Significance of flora with special reference to Pakistan. – Pakistan Journal of Botany 40(3): 967-971.
[3] Ali, S. I., Nasir, Y. J. (1989-1991): Flora of Pakistan. – Department of Botany, University of Karachi, Karachi and National Herbarium, Islamabad.
[4] Ali, S. I., Qaiser, M. (1995-2017): Flora of Pakistan. – Department of Botany, University of Karachi, Karachi.
[5] Badshah, L., Hussain, F., Sher, Z. (2013): Floristic inventory, ecological characteristics and biological spectrum of rangeland, District Tank, Pakistan. – Pakistan Journal of Botany 45(4): 1159-1168.
[6] Bhat, D. M., Murali, K. S. (2001): Phenology of understory species of tropical moist forest of Western Ghats region of Uttara Kannada district in South India. – Curr. Sci. 81: 799-805.
[7] Cornejo-Tenorio, G., Ibarra-Manríquez, G. (2007): Plant reproductive phenology in a temperate forest of the Monarch Butterfly Biosphere Reserve, Mexico. – Interciencia 32: 445-452.
[8] Durrani, M. J., Hussain, F., Rehman, S. U. (2005): Ecological characteristics of plants of Harboi rangeland, Kalat, Pakistan. – J. Trop. & Sub Trop. Bot. 13(2): 130-138.
[9] Giusti, L., Slanis, A., Acenolaza, P. (1995): Phytosociology of alder woods (*Alnus acuminate* subspecies. *acuminata*) of Tucuman, Argentina. – Lilloa 38(2): 93-120.
[10] Gu, Z., Gu, L., Eils, R., Schlesner, M., Brors, B. (2014): Circlize implements and enhances circular visualization in R. Bioinformatics 30: 2811-2812.
[11] Hussain, F. (1989): Field and Laboratory Manual of Plant Ecology. – UGC, Islamabad.
[12] Ijaz, F. (2014): Biodiversity and traditional uses of plants of Sarban Hills, Abbottabad. – M. Phil. Thesis Hazara University Mansehra, KP, Pakistan.
[13] Ijaz, F., Iqbal, Z., Alam, J., Khan, S. M., Afzal, A., Rahman, I., Afzal, M., Islam, M., Sohail (2015): Ethno medicinal study upon folk recipes against various human diseases in Sarban Hills, Abbottabad, Pakistan. – World Journal of Zoology 10: 41-46.
[14] Ijaz, F., Iqbal, Z., Rahman, I. U., Alam, J., Khan, S. M., Shah, G. M., Khan, K., Afzal, A. (2016): Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan. – Journal of Ethnopharmacology 179: 208-233.
[15] Iqbal, M., Khan, S., Khan, M. A., Rahman, I. U., Abbas, Z., Zahidullah. (2015): Exploration and inventorying of weeds in wheat crop of the district Malakand, Pakistan. – Pakistan Journal of Weed Science Research 21(3): 435-452.
[16] Jabeen, A., Khan, M. A., Ahmad, M., Zafar, M., Ahmad, F. (2009): Indigenous uses of economically important Flora of Margallah Hills National Park, Islamabad, Pakistan. – African Journal of Biotechnology 8(5): 763-784.
[17] Khan, S. M. (2012): Plant communities and vegetation ecosystem services in the Naran Valley, Western Himalaya. – Doctoral dissertation, University of Leicester, UK.
[18] Khan, K. U, Shah, M., Ahmad, H., Ashraf, M., Rahman, I. U., Iqbal, Z., Khan, S. M., Majid, A. (2015a): Investigation of Traditional Veterinary Phytomedicines Used in Deosai Plateau, Pakistan. – Global Veterinary 15(4): 381-388.


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DOI: http://dx.doi.org/10.15666/aeer/1702_14751498

[19] Khan, S. M., Din, N. U., Ilyas, M., Sohail, Rahman, I. U., Ijaz, F., Iqbal, Z., Ali, Z. (2015b): Ethnobotanical study of some medicinal plants of Tehsil Kabal, Distrct Swat, KP, Pakistan. – Medicinal and Aromatic Plants 4: 189.
[20] Khattak, N. S., Nouroz, F., Rahman, I. U., Noreen. S. (2015): Ethno veterinary uses of medicinal plants of district Karak, Pakistan. – Journal of Ethnopharmacology 171: 273-279.
[21] Malik, Z.H., Hussain, F. (1990): Phytosociology of some parts of Kotli Hills, Azad Kashmir. – Journal of Science Technology 14: 177-123.
[22] Manske, L. L. (2006): Westren Snowberry Biology. Annual Report. – North Dakota State University, Dickinson Research Extension Center, Dickinson, ND.
[23] Nasir, E., Ali, S. I. (1971-1989): Flora West of Pakistan. – Department of Botany, University of Karachi, Karachi and National Herbarium, Islamabad.
[24] Oosting, H. J. (1956): The Study of Plant Communities. 2nd Ed. – W. H. Freeman and Co., San Fransisco.
[25] Qureshi, R., Bhatti, G. R. (2008): Diversity of micro-habitats and their plant resources in Nara Desert, Pakistan. – Pakistan Journal of Botany 40(3): 979-992.
[26] Rahman, I. U., Ijaz, F., Afzal, A., Iqbal, Z., Ali, N., Khan, S. M. (2016a): Contributions to the phytotherapies of digestive disorders; Traditional knowledge and cultural drivers of Manoor Valley, Northern Pakistan. – Journal of Ethnopharmacology 192: 30-52.
[27] Rahman, I. U., Ijaz, F., Iqbal, Z., Afzal, A., Ali, N., Afzal, M., Khan, M. A., Muhammad, S., Qadir, G., Asif, M. (2016b): A novel survey of the ethno medicinal knowledge of dental problems in Manoor Valley (Northern Himalaya), Pakistan. – Journal of Ethnopharmacology 194C: 877-894.
[28] Rahman, I. U., Ijaz, F., Iqbal, Z., Afzal, A., Ali, N., Khan, M. A., Afzal, M., Muhammad, S., Qadir, G., Asif, M. (2016c): Graphical dataset on important medicinal plants used for curing dental issues in Manoor Valley, Mansehra, Pakistan. – Data in Brief 9: 1028-1033.
[29] Rahman, I. U., Afzal, A. F., Iqbal, Z. A., Ijaz, F., Ali, N., Asif, M., Alam, J., Majid, A., Bussmann, R. W., Hart, R. (2018a): First insights into the floristic diversity, biological spectra and phenology of Manoor Valley, Pakistan. – Pakistan Journal of Botany 50: 1113-24.
[30] Rahman, I. U., Afzal, A., Iqbal, Z., Ijaz, F., Ali, N., Shah, M., Ullah, S., Bussmann, R. W. (2018b): Historical perspectives of ethnobotany. – Clinics in Dermatology. https://doi.org/10.1016/j.clindermatol.2018.03.018.
[31] Rahman, I. U., Afzal, A., Iqbal, Z., Ijaz, F., Ali, N., Bussmann, R. W. (2018c): Traditional and ethnomedicinal dermatology practices in Pakistan. – Clinics in Dermatology 36(3): 310-319.
[32] Raunkiær, C. C. (1934): The Life Forms of Plants and Statistical Plants Geography. – Clarendon Press, Oxford.
[33] Rokaya, M. B., Münzbergová, Z., Shrestha, M. R., Timsina, B. (2012): Distribution patterns of medicinal plants along an elevational gradient in central Himalaya, Nepal. – Journal of Mountain Science 9(2): 201-213.
[34] Rokaya, M. B., Uprety, Y., Poudel, R. C., Timsina, B., Münzbergová, Z., Asselin, H., Tiwari, A., Shrestha, S. S., Sigdel, S. R. (2014): Traditional uses of medicinal plants in gastrointestinal disorders in Nepal. – Journal of Ethnopharmacology 158: 221-229.
[35] Safidkon, F., Kalvandi, R., Atri, M., Barazandeh, M. M. (2003): Contribution for the characterization of *Thymus eriocalyx* Chemotypes. – The International Magazine for Cosmetics and Fragrances.
[36] Shaheen, H., Qureshi, R. A. (2011): Vegetation types of Sheosar Lake and surrounding landscape in Deosai Plains of North Pakistan, Western Himalayas. – Journal of Medicinal Plant Research 5(4): 599-603.
[37] Shaheen, S., Iqbal, Z., Ijaz, F., Alam, J., Rahman, I. U. (2016): Floristic composition, biological spectrum and phenology of Tehsil Havelian, District Abbottabad, Pakistan. – Pakistan Journal of Botany 48(5): 1849-1859.


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DOI: http://dx.doi.org/10.15666/aeer/1702_14751498

[38] Shimwell, D. W. (1971): The description and Classification of Vegetation. – Sedgwick & Jackson, London.
[39] Singh, J. S., Singh, V. K. (1992): Phenology of seasonally dry tropical forest. – Current Sci. 63: 684-689.
[40] Vilela, A. A., Del Claro, V. T. S., Torezan-Silingardi, H. M., Del-Claro, K. (2017): Climate changes affecting biotic interactions, phenology, and reproductive success in a savanna community over a 10-year period. – Arthropod-Plant Interactions 12: 215-227.
[41] Walter, W., Hamilton, A. (1993): The vital wealth of plants. – Bates and Sons Ltd., UK.
[42] Zhang, J. T., Ru, W. M., Li, B. (2006): Relationships between vegetation and climate on the Loess Plateau in China. – Folia Geobot. 41: 151-163.

## APPENDIX

*Floristic composition, biological and leaf spectra, and phenological behaviour of the plant species of Manoor Valley, Pakistan*

| S. No | Family name/ Scientific name | Habit | Biological spectrum | | Phenology | |
|---|---|---|---|---|---|---|
| | | | Life form | Leaf size | Flowering | Fruiting |
| | **Acanthaceae** | | | | | |
| 1 | *Dicliptera bupleuroides* Nees | H | Th | N | Sept | Feb |
| 2 | *Justicia adhatoda* L. | S | NanP | Me | March | May |
| | **Adiantaceae** | | | | | |
| 3 | *Adiantum capillus-veneris* L. | H | G | N | July | Sept |
| 4 | *Adiantum indicum* J. Ghatak | H | G | Me | July | Aug |
| 5 | *Adiantum venustum* D. Don | H | G | N | June | Aug |
| 6 | *Asplenium adiantum-nigrum* L. | H | HemC | N | July | Sept |
| | **Adoxaceae** | | | | | |
| 7 | *Viburnum cotinifolium* D. Don | S | NanP | Ma | March | May |
| 8 | *Viburnum grandiflorum* Wall. ex DC. | S | NanP | Ma | March | May |
| | **Amaranthaceae** | | | | | |
| 9 | *Achyranthes aspera* L. | H | Th | N | May | July |
| 10 | *Achyranthes bidentata* Blume | H | Th | Mi | Aug | Sept |
| 11 | *Amaranthus viridis* L. | H | Th | Mi | Aug | Sept |
| 12 | *Celosia argentea* L. | H | Th | N | Aug | Sept |
| | **Apiaceae** | | | | | |
| 13 | *Aegopodium burttii* Nasir | H | HemC | Mi | June | July |
| 14 | *Anthriscus nemorosa* (M.Bieb.) Spreng. | H | Th | Mi | April | Aug |
| 15 | *Bupleurum nigrescens* E. Nasir | H | Th | N | June | Sept |
| 16 | *Bupleurum gracillimum* Klotzsch | H | Th | N | June | Sept |
| 17 | *Bupleurum longicaule* Wall. ex DC. | H | Th | N | June | Sept |
| 18 | *Foeniculum vulgare* Mill. | H | Th | N | July | Sept |
| 19 | *Heracleum candicans* Wall. ex DC. | H | HemC | L | April | June |
| 20 | *Pimpinella stewartii* (Dunn) Nasir | H | Th | N | July | Sept |
| 21 | *Pleurospermum brunonis* Benth. ex C.B.Clarke | H | HemC | L | June | Aug |


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| | | | | | | |
|---|---|---|---|---|---|---|
| 22 | *Pleurospermum candollei* Benth. ex C.B.Clarke | H | HemC | L | July | Aug |
| 23 | *Pleurospermum stellatum* (D. Don) Benth. ex C.B. Clarke | H | HemC | L | July | Aug |
| 24 | *Pleurospermum stylosum* C.B. Clarke | H | HemC | L | July | Aug |
| 25 | *Sanicula elata* Buch.-Ham. ex D.Don | H | Th | Mi | May | July |
| 26 | *Seseli libanotis* (L.) W.D.J.Koch . | H | HemC | N | April | Aug |
| 27 | *Torilis japonica* (Houtt.) DC. | H | Th | Mi | June | July |
| 28 | *Trachyspermum amii* (L.) Sprague | H | Th | L | May | July |
| | **Araceae** | | | | | |
| 29 | *Arisaema flavum* (Forsk.) Schott | H | G | Ma | June | Sept |
| 30 | *Arisaema jacquemontii* Blume | H | G | Me | June | July |
| 31 | *Sauromatum venosum* (Dryand. ex Aiton) Kunth | H | G | Me | May | Aug |
| | **Araliaceae** | | | | | |
| 32 | *Aralia cachemirica* Decne. | H | HemC | Me | May | June |
| 33 | *Hedera nepalensis* K. Koch | H | L | Me | Oct | April |
| | **Asclepiadaceae** | | | | | |
| 34 | *Periploca aphylla* Decne. | S | NanP | Aph | May | July |
| 35 | *Vincetoxicum petrense* (Hemsl. & Lace) Rech. f. | H | Ch | Ma | June | July |
| | **Asparagaceae** | | | | | |
| 36 | *Asparagus fiicinus* Buch.-Ham. ex D. Don | H | G | Mi | May | June |
| | **Asteraceae** | | | | | |
| 37 | *Achillea millefolium* L. | H | Th | N | May | Sept |
| 38 | *Ainsliaea aptera* DC. | H | HemC | Ma | Dec | June |
| 39 | *Anaphalis margaritacea* (L.) Benth. | H | HemC | N | Aug | Sept |
| 40 | *Anaphalis busua* (Buch.-Ham.) DC. | H | HemC | N | Sept | Oct |
| 41 | *Anaphalis contorta* (D.Don) Hook.f. | H | HemC | N | Sept | Oct |
| 42 | *Anaphalis nepalensis* (Spreng.) Hand.-Mazz. | H | HemC | N | May | Sept |
| 43 | *Arctium minus* (Hill) Benh. | H | HemC | Me | June | Aug |
| 44 | *Artemisia absinthium* L. | H | Th | N | July | Aug |
| 45 | *Carpesium nepalense* Less. | H | Th | N | June | Sept |
| 46 | *Chrysanthemum indicum* L. | H | HemC | Mi | Oct | Nov |
| 47 | *Cichorium intybus* L. | H | Th | N | July | Aug |
| 48 | *Cirsium arvense* (L.) Scop. | H | Th | N | Aug | Oct |
| 49 | *Cirsium falconeri* (Hook.f.) Petr. | H | Th | N | July | Aug |
| 50 | *Conyza japonica* (Thunb.) Less. ex Less. | H | Th | Mi | July | Aug |
| 51 | *Cyanthillium cinereum* (L.) H.Rob. | H | HemC | Mi | June | July |
| 52 | *Erigeron canadensis* L. | H | Th | L | July | Aug |
| 53 | *Galinosoga parviflora* Cav. | H | Th | Mi | July | Sept |
| 54 | *Gerbera gossypina* (Royle) Beauverd | H | HemC | Mi | April | June |
| 55 | *Helianthus annuus* L. | H | Th | Ma | May | June |
| 56 | *Inula cuspidata* (Wall. ex DC.) C.B.Clarke | H | Th | Mi | June | Sept |


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| | | | | | | |
|---|---|---|---|---|---|---|
| 57 | *Inula falconeri* Hook.f. | H | Th | Me | June | Oct |
| 58 | *Lactuca tatarica* (L.) C.A.Mey | H | Th | Mi | May | July |
| 59 | *Launaea procumbens* (Roxb.) Ramayya & Rajagopal | H | Ch | Mi | March | May |
| 60 | *Leucanthemum vulgare* Lam. | H | HemC | L | June | Sept |
| 61 | *Ligularia amplexicaulis* DC. | H | HemC | Ma | May | Aug |
| 62 | *Onopordum acanthium* L. | H | G | Me | April | June |
| 63 | *Parthenium hysterophorus* L. | H | HemC | N | All the year | All the year |
| 64 | *Saussurea sp.* | H | HemC | Me | March | May |
| 65 | *Senecio analogus* DC. | H | Th | Mi | Aug | Sept |
| 66 | *Senecio chrysanthemoides* DC. | H | Th | Me | Oct | Nov |
| 67 | *Silybum marianum* (L.) Gaertn. | H | Ch | Me | March | June |
| 68 | *Sonchus asper* (L.) Hill | H | Th | Mi | July | Aug |
| 69 | *Tagetes minuta* L. | H | Th | Mi | Sept | Oct |
| 70 | *Taraxacum campylodes* G.E.Haglund | H | HemC | Mi | May | Aug |
| 71 | *Tussilago farfara* L. | H | Th | Me | Feb | May |
| 72 | *Xanthium strumarium* L. | H | Th | Me | July | Sept |
| | **Balsaminaceae** | | | | | |
| 73 | *Impatiens bicolor* Royle. | H | Th | Me | July | Sept |
| 74 | *Impatiens brachycentra* Kar. & Kir. | H | Th | Mi | July | Sept |
| | **Berberidaceae** | | | | | |
| 75 | *Berberis lycium* Royle | S | NanP | L | June | July |
| 76 | *Berberis pachyacantha* Bien. ex Koehne | S | NanP | L | Feb | July |
| 77 | *Berberis parkeriana* C.K.Schneid. | S | NanP | L | Feb | July |
| 78 | *Epimedium elatum* C.Morren & Decne. | H | Th | Me | April | May |
| | **Betulaceae** | | | | | |
| 79 | *Alnus nitida* (Spach) Endl. | T | MesP | Me | July | Sept |
| 80 | *Corylus colurna* L. | T | MesP | Me | April | June |
| | **Boraginaceae** | | | | | |
| 81 | *Cynoglossum apenninum* L. | H | HemC | N | June | Aug |
| 82 | *Cynoglossum glochidiatum* Wall. ex Benth. | H | HemC | N | June | Aug |
| 83 | *Cynoglossum microglochin* Benth. | H | HemC | N | June | Aug |
| 84 | *Hackelia uncinata* (Benth.) C.E.C.Fisch. | H | G | Mi | June | Aug |
| 85 | *Lindelofia* sp. | H | Th | N | June | Aug |
| 86 | *Myosotis sp.* | H | HemC | Mi | May | July |
| 87 | *Pseudomertensia parviflorum* (Decne.) Riedl | H | HemC | N | May | July |
| 88 | *Pseudomertensia trollii* Stewart & Kazmi | H | HemC | N | May | Aug |
| | **Brassicaceae** | | | | | |
| 89 | *Brassica campestris* Dunn. | H | Th | Ma | June | July |
| 90 | *Capsella bursa-pastoris* (L.) Medik. | H | Th | N | June | Aug |
| 91 | *Erysimum melicentae* Dunn. | H | Th | Mi | July | Sept |
| 92 | *Sisymbrium irio* L. | H | Th | N | April | June |
| 93 | *Nasturtium officinale* R.Br. | H | G | Mi | May | July |


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|---|---|---|---|---|---|---|
| | **Buxaceae** | | | | | |
| 94 | *Sarcococca saligna* Mull.Arg. | S | NanP | Mi | Dec | March |
| | **Caesalpiniaceae** | | | | | |
| 95 | *Bauhinia variegata* L. | T | MicP | Me | March | April |
| | **Cannabaceae** | | | | | |
| 96 | *Cannabis sativa* L. | H | Th | Mi | July | Sept |
| 97 | *Celtis australis* L. | T | MesP | Ma | May | Aug |
| | **Caprifoliaceae** | | | | | |
| 98 | *Lonicera caerulea* L. | S | NanP | Mi | March | May |
| 99 | *Valeriana jatamansi* Jones | H | G | Me | May | July |
| | **Caryophyllaceae** | | | | | |
| 100 | *Minuartia biflora* L. | H | HemC | L | Aug | Sept |
| 101 | *Minuartia kashmirica* (Edgew.) Mattf. | H | Ch | L | July | Sept |
| 102 | *Silene conoidea* L. | H | Th | N | April | May |
| 103 | *Silene vulgaris* (Moench) Garcke | H | Th | N | July | Sept |
| 104 | *Stellaria media* (L.) Vill. | H | Th | N | Oct | Nov |
| 105 | *Stellaria monosperma* Buch.-Ham. ex D. Don | H | Th | Mi | Sept | Oct |
| | **Celastraceae** | | | | | |
| 106 | *Gymnosporia royleana* Wall. ex M.A.Lawson | S | NanP | Mi | March | May |
| | **Chenopodiaceae** | | | | | |
| 107 | *Chenopodium album* L. | H | HemC | N | June | Sept |
| 108 | *Dysphania ambrosioides* (L.) Mosyakin & Clemants | H | Th | Mi | May | June |
| | **Clusiaceae** | | | | | |
| 109 | *Hypericum perforatum* L. | H | Ch | N | July | Sept |
| | **Colchicaceae** | | | | | |
| 110 | *Colchicum luteum* Baker | H | G | N | July | Sept |
| | **Commelinaceae** | | | | | |
| 111 | *Commelina benghalensis* L. | H | Ch | N | Sept | Oct |
| | **Convallariaceae** | | | | | |
| 112 | *Polygonatum verticillatum* (L.) Allioni | H | Th | N | June | Aug |
| 113 | *Polygonatum sp.* | H | Th | Mi | May | July |
| | **Convolvulaceae** | | | | | |
| 114 | *Convolvulus arvensis* L. | H | HemC | N | May | July |
| 115 | *Ipomoea nil* (L.) Roth | H | Th | Mi | May | July |
| | **Cornaceae** | | | | | |
| 116 | *Cornus macrophylla* Wall. | T | MesP | Ma | March | May |
| 117 | *Cornus oblonga* Wall. | T | MesP | Me | June | Sept |
| | **Crassulaceae** | | | | | |
| 118 | *Sedum album* L. | H | Ch | N | July | Oct |
| 119 | *Hylotelephium ewersii* Ledeb. | H | Ch | Mi | Oct | Nov |
| 120 | *Sedum fischeri* Raym.-Hamet | H | Th | L | July | Sept |
| | **Cucurbitaceae** | | | | | |
| 121 | *Luffa sp.* | H | Th | Mi | June | July |
| 122 | *Solena amplexicaulis* (Lam.) Gandhi | H | Th | Mi | Aug | Oct |


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|---|---|---|---|---|---|---|
| | **Cupressaceae** | | | | | |
| 123 | *Juniperus communis* L. | S | NanP | L | June | July |
| 124 | *Juniperus squamata* Buch.-Ham. ex D.Don | S | NanP | L | June | Sept |
| 125 | *Juniperus excelsa* M.Bieb. | T | NanP | L | June | Oct |
| | **Cuscutaceae** | | | | | |
| 126 | *Cuscuta reflexa* Roxb. | Pp | Pp | Aph | Aug | Sept |
| | **Cyperaceae** | | | | | |
| 127 | *Carex sp.* | H | G | N | March | May |
| 128 | *Cyperus rotundus* L. | H | G | N | Aug | Oct |
| 129 | *Cyperus odoratus* L. | H | G | N | Aug | Sept |
| | **Dioscoreaceae** | | | | | |
| 130 | *Dioscorea deltoidea* Wall. ex Griseb. | H | HemC | Mi | Nov | Dec |
| | **Dipsacaceae** | | | | | |
| 131 | *Dipsacus inermis* Wall. in Roxb. | H | Ch | Me | May | July |
| | **Dryopteridaceae** | | | | | |
| 132 | *Dryopteris wallichiana* (Spreng.) Hyl. | H | G | Me | July | Aug |
| | **Dennstaedtiaceae** | | | | | |
| 133 | *Pteridium aquilinum* (L.) Kuhn | H | G | Ma | Aug | Nov |
| | **Ebenaceae** | | | | | |
| 134 | *Diospyros lotus* L. | T | MicP | Ma | June | Nov |
| | **Eleagnaceae** | | | | | |
| 135 | *Elaeagnus umbellata* Thunb. | S | NanP | Mi | April | May |
| | **Ephedraceae** | | | | | |
| 136 | *Ephedra girardiana* Wall. ex. Stapf | S | Ch | Aph | Aug | Oct |
| | **Equisetaceae** | | | | | |
| 137 | *Equisetum arvense* L. | H | G | Aph | April | May |
| | **Ericaceae** | | | | | |
| 138 | *Cassiope fastigiata* (Wall.) D.Don | H | Th | L | May | July |
| 139 | *Lyonia ovalifolia* (Wall.) Drude | S | NanP | Mi | May | Oct |
| 140 | *Rhododendron arboreum* Sm. | T | MicP | Me | April | May |
| | *Rhododendron hypenanthum* Balf. f. | S | NanP | Me | April | May |
| 141 | **Euphorbiaceae** | | | | | |
| 142 | *Euphorbia helioscopia* L. | H | Th | N | May | June |
| 143 | *Euphorbia prostrata* Ait. | H | Ch | N | All the year | All the year |
| 144 | *Euphorbia hirta* L. | H | Th | N | Aug | Oct |
| 145 | *Euphorbia serpens* Kunth | H | HemC | N | June | July |
| 146 | *Euphorbia wallichii* Hook. f. | H | Th | N | Aug | Oct |
| 147 | *Ricinus communis* L. | S | NanP | Me | June | Oct |
| | **Fagaceae** | | | | | |
| 148 | *Castanea sativa* Mill. | T | MesP | Ma | May | July |
| 149 | *Quercus incana* Bartram | T | MesP | Mi | May | July |
| | **Fumaricaceae** | | | | | |
| 150 | *Fumaria indica* (Hausskn) Pugsley | H | Th | N | April | June |
| | **Gentianaceae** | | | | | |
| 151 | *Gentianodes clarkei* (Kusn.) Omer | H | Th | N | Aug | Oct |


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|---|---|---|---|---|---|---|
| 152 | *Lomatogonium spathulatum* (A. Kern.) Fernald | H | Th | N | April | May |
| 153 | *Swertia paniculata* Wall. | H | Th | L | July | Aug |
| 154 | *Swertia ciliata* (D. Don ex G. Don) B.L. Burtt | H | Th | L | July | Aug |
| 155 | *Swertia cordata* (Wall. ex G. Don) C.B. Clarke | H | Th | L | July | Aug |
| | **Geraniaceae** | | | | | |
| 156 | *Geranium nepalense* Sweet. | H | Ch | Mi | July | Oct |
| 157 | *Geranium wallichianum* D.Don ex Sweet | H | Ch | Mi | July | Oct |
| | **Hamamelidaceae** | | | | | |
| 158 | *Parrotiopsis jacquemontiana* (Decne.) Rehder | S | NanP | Mi | June | Aug |
| | **Hippocastanaceae** | | | | | |
| 159 | *Aesculus indica* (Wall. ex Camb.) Hook. | T | MegP | Me | July | Aug |
| 160 | *Hippolytia dolichophylla* (Kitam.) K.Bremer & Humphries | H | HemC | Me | May | Oct |
| | **Juglandaceae** | | | | | |
| 161 | *Juglans regia* L. | T | MegP | Ma | July | Aug |
| | **Juncaceae** | | | | | |
| 162 | *Juncus* sp. | H | G | N | Sept | Nov |
| | **Lamiaceae** | | | | | |
| 163 | *Ajuga integrifolia* Buch.-Ham. | H | HemC | Mi | May | July |
| 164 | *Calamintha umbrosa* (M.Bieb.) Rchb.Benth.) Hedge | H | Th | N | July | Sept |
| 165 | *Clinopodium vulgare* L. | H | HemC | Mi | April | June |
| 166 | *Colebrookea oppositifolia* Sm. | S | NanP | L | July | Oct |
| 167 | *Dracocephalum nutans* L. | H | Th | N | July | Sept |
| 168 | *Elsholtzia ciliata* (Thunb.) Hyl. | H | Th | N | July | Sept |
| 169 | *Isodon rugosus* (Wall. ex Benth.) Codd | S | NanP | Mi | May | Oct |
| 170 | *Lamium album* L. | H | Th | Mi | July | Oct |
| 171 | *Lamium amplexicaule* L. | H | Th | Mi | July | Oct |
| 172 | *Mentha piperita* L. | H | HemC | N | June | Sept |
| 173 | *Mentha royleana* Wall. ex Benth. | H | HemC | Mi | June | Oct |
| 174 | *Micromeria biflora* (Ham.) Bth. | H | Ch | L | April | June |
| 175 | *Nepeta graciliflora* Benth. | H | Th | Mi | July | Sept |
| 176 | *Nepeta laevigata* (D. Don) Hand.- Mazz | H | Th | Mi | July | Sept |
| 177 | *Origanum majorana* L. | H | Th | N | June | Aug |
| 178 | *Origanum vulgare* L. | H | Th | N | July | Aug |
| 179 | *Prunella vulgaris* L. | H | HemC | N | Sept | Nov |
| 180 | *Rydingia limbata* (Benth.) Scheen & V.A. Albert | S | NanP | L | July | Aug |
| 181 | *Salvia lanata* Roxb. | H | Ch | Mi | April | July |
| 182 | *Salvia moorcroftiana* Wall. ex. Benth. | S | Th | Me | March | June |
| 183 | *Salvia nubicola* Wall. ex Sweet | H | Th | Me | June | Aug |
| 184 | *Thymus linearis* Benth. | H | HemC | N | July | Sept |


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|---|---|---|---|---|---|---|
| | **Liliaceae** | | | | | |
| 185 | *Gagea lutea* (L.) Ker Gawl. | H | G | N | Mar | May |
| | **Linaceae** | | | | | |
| 186 | *Reinwardtia trigyna* Planch. | H | Ch | L | June | July |
| | **Lythraceae** | | | | | |
| 187 | *Punica granatum* L. | S | NanP | Mi | May | July |
| | **Malvaceae** | | | | | |
| 188 | *Alcea rosea* L. | H | HemC | Ma | April | July |
| 189 | *Grewia optiva* J.R.Drumm. ex Burret | T | MesP | N | April | June |
| 190 | *Lavatera cachemiriana* Camb. in Jacq. | H | HemC | Me | May | July |
| 191 | *Malva parviflora* L. | H | HemC | Mi | April | June |
| 192 | *Malva neglecta* Wallr. | H | HemC | Mi | May | July |
| 193 | *Malvastrum coromandelianum* (L.) Garcke | H | HemC | N | April | Oct |
| 194 | *Sida cordata* (Burm.f.) Borss.Waalk. | H | HemC | N | May | Sept |
| | **Meliaceae** | | | | | |
| 195 | *Melia azedarach* L. | T | MesP | Me | April | July |
| | **Mimosaceae** | | | | | |
| 196 | *Acacia modesta* Wall. | T | MicP | L | March | May |
| 197 | *Acacia nilotica* (L.) Delile | T | MesP | L | April | Oct |
| | **Moraceae** | | | | | |
| 198 | *Ficus carica* L. | T | MicP | Me | May | Aug |
| | **Oleaceae** | | | | | |
| 199 | *Fraxinus hookeri* Wenz. | T | MicP | Me | April | Oct |
| 200 | *Fraxinus xanthoxyloides* (G. Don) DC | T | MicP | Me | May | Sept |
| 201 | *Jasminum humile* L. | S | NanP | N | June | Aug |
| 202 | *Jasminum sambac* (L.) Aiton | S | NanP | N | June | Aug |
| 203 | *Olea ferruginea* Wall. ex Aitch. | T | MesP | Mi | April | June |
| | **Onagraceae** | | | | | |
| 204 | *Circaea cordata* Royle. | H | Th | Me | June | Sept |
| 205 | *Circaea alpina* L. | H | Th | Mi | June | Sept |
| 206 | *Epilobium hirsutum* L. | H | Ch | Mi | May | July |
| 207 | *Epilobium latifolium* L. | H | HemC | L | July | Sept |
| 208 | *Oenothera rosea* L. Her ex Aiton | H | Th | N | June | Aug |
| | **Orchidaceae** | | | | | |
| 209 | *Spiranthes sinensis* (Pers.) Ames | H | G | N | June | Sept |
| | **Orobanchaceae** | | | | | |
| 210 | *Euphrasia himalayica* Wetts. | H | Th | L | July | Oct |
| 211 | *Pedicularis punctata* Decne. | H | HemC | N | July | Aug |
| | **Oxalidaceae** | | | | | |
| 212 | *Oxalis corniculata* L. | H | HemC | N | May | Sept |
| | **Papaveraceae** | | | | | |
| 213 | *Corydalis cornuta* Royle | H | Th | L | Oct | Nov |
| 214 | *Corydalis carinata* Lidén & Z.Y.Su | H | Th | L | July | Sept |
| 215 | *Corydalis virginea* Lidén & Z.Y.Su | H | HemC | N | March | April |
| | **Papilionaceae** | | | | | |
| 216 | *Astragalus grahamianus* Benth. | S | Ch | L | Sept | Nov |


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|---|---|---|---|---|---|---|
| 217 | *Astragalus psilocentros* Fisch. | H | Ch | N | May | Aug |
| 218 | *Campylotropis meeboldii* (Schindl.) Schindl. | S | NanP | L | June | Aug |
| 219 | *Crotalaria* sp. | H | Th | N | May | July |
| 220 | *Desmodium elegans* DC. | S | NanP | Me | July | Aug |
| 221 | *Indigofera heterantha* Brandis | S | NanP | L | July | Oct |
| 222 | *Indigofera australis* Willd. | S | NanP | N | May | Aug |
| 223 | *Indigofera hebepetala* Baker | S | NanP | N | May | Aug |
| 224 | *Lathyrus aphaca* L. | H | Th | N | April | June |
| 225 | *Lathyrus sativa* L. | H | Th | N | July | Sept |
| 226 | *Lathyrus odoratus* L. | H | Th | L | July | Sept |
| 227 | *Lotus corniculatus* L. | H | HemC | Mi | Aug | Sept |
| 228 | *Medicago sativa* L. | H | HemC | N | June | Sept |
| 229 | *Rhynchosia pseudo-cajan* Cambess. | S | NanP | Me | May | July |
| 230 | *Robinia pseudo-acacia* L. | T | MesP | Me | April | May |
| 231 | *Trifolium repens* L. | H | G | N | June | July |
| 232 | *Vicia sativa* L. | H | HemC | N | April | May |
| | **Phyllanthaceae** | | | | | |
| 233 | *Leptopus chinensis* (Bunge) Pojark. [Syn. *Andrachne cordifolia* (Decne.) Mull.Avg.] | S | NanP | Me | May | July |
| | **Phytolaccaceae** | | | | | |
| 234 | *Phytolacca americana* L. | H | Th | Mi | Aug | Sept |
| 235 | *Phytolacca latbenia* (Moq.) H. Walter | H | Ch | Ma | June | Aug |
| | **Pinaceae** | | | | | |
| 236 | *Abies pindrow* (Royle ex D.Don) Royle | T | MegP | L | June | July |
| 237 | *Cedrus deodara* (Roxb. ex Lamb.) G. Don | T | MegP | L | Sept | Oct |
| 238 | *Picea smithiana* (Wall.) Boiss. | T | MegP | L | May | July |
| 239 | *Pinus roxburghii* Sarg | T | MegP | L | May | July |
| 240 | *Pinus wallichiana* A.B.Jacks. | T | MegP | L | May | July |
| | **Plantaginaceae** | | | | | |
| 241 | *Plantago himalaica* Pilger. | H | HemC | Mi | July | Aug |
| 242 | *Plantago lanceolata* L. | H | HemC | Mi | April | July |
| 243 | *Plantago major* L. | H | HemC | Mi | July | Sept |
| 244 | *Veronica anagallis* L. | H | HemC | Mi | June | July |
| 245 | *Wulfeniopsis amherstiana* (Benth.) D.Y. Hong [Syn. *Wulfenia amherstiana* Benth.] | H | Th | N | April | July |
| | **Platanaceae** | | | | | |
| 246 | *Platanus orientalis* L. | T | MegP | Ma | June | July |
| | **Poaceae** | | | | | |
| 247 | *Arundo donax* L. | S | Ch | Mi | July | Sept |
| 248 | *Avena sativa* L. | H | Th | N | May | July |
| 249 | *Bromus diandrus* Roth. | H | Th | L | April | July |
| 250 | *Bromus secalinus* L. | H | Th | L | March | June |
| 251 | *Bromus tectorum* L. | H | Th | L | June | Sept |
| 252 | *Cynodon dactylon* (L.) Pers. | H | HemC | L | June | Sept |


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|---|---|---|---|---|---|---|
| 253 | *Dactylis glomerata* L. | H | HemC | N | July | Sept |
| 254 | *Paspalum dilatatun* Poir. | H | HemC | N | April | Sept |
| 255 | *Pennisetum orientale* Rich. | H | HemC | L | June | Sept |
| 256 | *Phragmites altissimus* (Benth.) Mabille | H | Th | Mi | Aug | July |
| 257 | *Piptatherum aequiglume* (Duthie ex Hook.f.) Roshev. | H | Th | L | May | Oct |
| 258 | *Poa alpina* L. | H | HemC | N | June | Sept |
| 259 | *Poa falconeri* Hook. f. | H | HemC | L | June | Sept |
| 260 | *Poa annua* L. | H | HemC | L | May | Aug |
| 261 | *Poa infirma* Kunth | H | HemC | L | April | June |
| 262 | *Saccharum spontaneum* L. | H | HemC | N | June | Aug |
| 263 | *Schismus arabicus* Nees. | H | HemC | L | June | July |
| 264 | *Sorghum halepense* (L.) Pers. | H | HemC | N | May | July |
| 265 | *Sporobolus diandrus* (Retz.) P.Beauv. | H | HemC | L | Sept | Sept |
| 266 | *Urochloa panicoides* P.Beauv. | H | HemC | N | July | June |
| | **Polygonaceae** | | | | | |
| 267 | *Bistorta affinis* (D.Don) Green | H | Ch | Mi | July | Aug |
| 268 | *Bistorta amplexicaulis* (D.Don) Greene | H | Ch | Mi | July | Aug |
| 269 | *Fagopyrum tataricum* (L.) Gaertn. | H | Th | Ma | July | Sept |
| 270 | *Oxyria digyna* (L.) Hill | H | Ch | Mi | June | July |
| 271 | *Persicaria capitata* (Buch.-Ham. ex D.Don) H.Gross | H | Th | L | June | Aug |
| 272 | *Polygonum plebeium* R.Br. | H | HemC | Mi | July | Oct |
| 273 | *Rheum australe* D. Don | H | Ch | Me | June | Aug |
| 274 | *Rumex dentatus* L. | H | Th | Me | Aug | Oct |
| 275 | *Rumex hastatus* D. Don | H | Th | N | June | Sept |
| 276 | *Rumex nepalensis* Sprenge | H | Th | Me | July | Oct |
| | **Portulacaceae** | | | | | |
| 277 | *Portulaca oleracea* L. | H | Th | N | May | July |
| | **Primulaceae** | | | | | |
| 278 | *Anagallis arvensis* L. | H | Ch | N | May | July |
| 279 | *Androsace hazarica* R.R. Stewart ex Y.Nasir | H | Th | Mi | May | July |
| 280 | *Androsace rotundifolia* Hardw. | H | Th | Mi | June | Aug |
| 281 | *Primula rosea* Y.J. Nasir | H | G | Mi | Oct | Nov |
| 282 | *Primula hazarica* Duthie | H | HemC | Mi | July | Aug |
| | **Pteridaceae** | | | | | |
| 283 | *Onychium contiguum* C.Hope | H | G | Me | June | June |
| 284 | *Pteris vittata* L. | H | G | Me | June | Aug |
| | **Ranunculaceae** | | | | | |
| 285 | *Aconitum heterophyllum* Wall. ex Royle | H | HemC | Me | June | Sept |
| 286 | *Anemone obtusiloba* D.Don | H | HemC | L | May | July |
| 287 | *Aquilegia pubiflora* Wall. ex Royle | H | HemC | Mi | June | Aug |
| 288 | *Caltha palustris* var. *alba* (Cambess) Hook.f. & Thomson | H | Th | Ma | July | Aug |
| 289 | *Clematis grata* Wall. | H | L | Mi | July | Sept |
| 290 | *Delphinium cashmerianum* Royle | H | Th | Mi | Aug | Sept |


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|---|---|---|---|---|---|---|
| 291 | *Ranunculus laetus* Wall. ex Hook. f. & J.W. Thompson | H | HemC | Me | June | Sept |
| 292 | *Ranunculus muricatus* L. | H | HemC | Ma | June | July |
| 293 | *Thalictrum pedunculatum* Edgew. | H | HemC | N | June | Aug |
| | **Rhamnaceae** | | | | | |
| 294 | *Rhamnus purpurea* Edgew. | T | NanP | Mi | May | July |
| 295 | *Ziziphus undulata* Reissek | S | NanP | Mi | June | Aug |
| | **Rosaceae** | | | | | |
| 296 | *Alchemilla cashmeriana* Rothum. | H | HemC | N | June | Sept |
| 297 | *Cotoneaster acuminatus* Wall. ex Lindl. | S | NanP | N | June | July |
| 298 | *Cotoneaster microphyllus* Wall. ex Lindl | S | NanP | N | May | July |
| 299 | *Duchesnea indica* (Andx) Fake. | H | HemC | N | April | June |
| 300 | *Filipendula vestita* (Wall. ex G. Don.) Maxim. | H | Th | Me | June | Aug |
| 301 | *Fragaria nubicola* (Hook. f.) Lindl. ex Lacaita | H | HemC | N | May | July |
| 302 | *Geum elatum* Wall. ex G.Don | H | HemC | N | Aug | Oct |
| 303 | *Malus domestica* Borkh. | T | MicP | Me | April | June |
| 304 | *Potentilla anserina* L. | H | HemC | L | June | Aug |
| 305 | *Potentilla argentea* L. | H | HemC | L | June | Sept |
| 306 | *Potentilla napalensis* Hook. | H | HemC | Mi | June | Sept |
| 307 | *Prunus cornuta* (Wall.ex Royle) Steud | T | MesP | Me | May | July |
| 308 | *Prunus armeniaca* L. | T | MesP | Mi | March | April |
| 309 | *Prunus domestica* L. | T | MesP | Me | May | Sept |
| 310 | *Pyrus pashia* Buch.-Ham. ex D.Don | T | MesP | Mi | April | May |
| 311 | *Rosa webbiana* Wall. ex. Royle | S | NanP | N | May | July |
| 312 | *Rosa brunonii* Lindl. | S | NanP | Mi | June | July |
| 313 | *Rubus fruticosus* Agg. | S | NanP | Mi | July | Sept |
| 314 | *Rubus sanctus* Schreber | S | NanP | Mi | July | Sept |
| 315 | *Sibbaldia procumbens* L. | H | HemC | N | Oct | Nov |
| 316 | *Sorbaria tomentosa* (Lindl.) Rehder | S | NanP | Me | June | Aug |
| 317 | *Sorbus tomentosa* Hedl. | S | NanP | Me | July | Aug |
| 318 | *Spiraea vaccinifolia* D.Don | S | NanP | Mi | April | July |
| 319 | *Spiraea affinis* R.Parker | S | NanP | Me | July | Aug |
| | **Rubiaceae** | | | | | |
| 320 | *Galium aparine* L. | H | Th | L | July | Oct |
| 321 | *Galium asparagifolium* Boiss. & Heldr. | H | Th | L | May | Aug |
| 322 | *Galium elagans* Wall. | H | Th | N | July | Aug |
| 323 | *Himalrandia tetrasperma* (Wall. ex Roxb.) T.Yamaz. | H | HemC | Mi | June | Aug |
| 324 | *Leptodermis virgata* Edgew. ex Hook.f. | H | Ch | N | May | June |
| | **Rutaceae** | | | | | |
| 325 | *Zanthoxylum armatum* DC. | S | MicP | Mi | July | Sept |
| | **Salicaceae** | | | | | |
| 326 | *Populus alba* L. | T | MesP | Ma | June | Aug |
| 327 | *Populus ciliata* Wall. ex Royle | T | MesP | Ma | May | June |


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|---|---|---|---|---|---|---|
| 328 | *Populus nigra* L. | T | MesP | Ma | June | Aug |
| 329 | *Salix alba* L. | T | MesP | Mi | June | Oct |
| 330 | *Salix denticulata* subsp. *hazarica* (R. Parker) Ali | T | MesP | Mi | June | Oct |
| 331 | *Salix tetrasperma* Roxb. | T | MesP | Mi | June | Oct |
| | **Sambucaceae** | | | | | |
| 332 | *Sambucus wightiana* Wall. ex Wight & Arn | S | Th | Me | July | Sept |
| | **Sapindaceae** | | | | | |
| 333 | *Acer caesium* Wall. ex Brandis | T | MegP | L | April | July |
| 334 | *Dodonaea viscosa* (L.) Jacq. | S | NanP | Me | April | Aug |
| | **Saxifragaceae** | | | | | |
| 335 | *Bergenia ciliata* (Haw.) Sternb. | H | Ch | Me | Aug | Oct |
| 336 | *Bergenia stracheyi* Hook.f & thomes. | H | HemC | Me | Sept | Oct |
| | **Scrophulariaceae** | | | | | |
| 337 | *Verbascum thapsus* L. | H | Th | Me | July | Aug |
| | **Simaroubaceae** | | | | | |
| 338 | *Ailanthus altissima* (Mill.) Swingle | T | MesP | Mi | May | July |
| | **Smilacaceae** | | | | | |
| 339 | *Smilax glaucophylla* Koltzsch | H | L | Mi | June | Aug |
| | **Solanaceae** | | | | | |
| 340 | *Hyoscyamus niger* L. | H | Th | Me | July | Sept |
| 341 | *Solanum nigrum* L. | H | Th | Mi | July | Oct |
| 342 | *Solanum surattense* Burm F. | H | Th | Me | All the year | All the year |
| 343 | *Withania somnifera* (L.) Dunal | H | Ch | Me | July | Oct |
| | **Thymelaeaceae** | | | | | |
| 344 | *Daphne mucronata* Royle | S | NanP | N | Nov | Feb |
| 345 | *Daphne papyracea* Wall. ex G. Don | S | NanP | N | Nov | Feb |
| | **Urticaceae** | | | | | |
| 346 | *Lecanthus peduncularis* (Wall. ex Royle) Wedd. Weed. | H | HemC | Mi | July | Sept |
| 347 | *Pilea umbrosa* Blume | H | Th | Mi | April | June |
| 348 | *Urtica dioica* L. | H | Th | Mi | Sept | Oct |
| | **Verbenaceae** | | | | | |
| 349 | *Pteracanthus urticifolius* (Wall. ex Kuntze) Bremek. | H | Th | Me | June | Aug |
| 350 | *Verbena officinalis* L. | H | Th | Mi | May | July |
| | **Violaceae** | | | | | |
| 351 | *Viola odorata* L. | H | Th | Mi | Sept | Oct |
| 352 | *Viola serpens* Wall. Ex Ging | H | G | Mi | Aug | Oct |
| | **Vitaceae** | | | | | |
| 353 | *Vitex negundo* L. | S | NanP | Mi | April | Aug |
| 354 | *Vitis jacquemontii* R. Parker | S | NanP | Me | June | Aug |

Abbreviations: H – Herb, Pp – Parasitic Plant, S – Shrub, T – Tree; Ch – Chamaephytes, G – Geophytes, HemC – Hemicryptophytes, L – Liana, MegP – Megaphanerophytes, MesP – Mesophanerophytes, MicP – Microphanerophytes, NanP – Nanophanerophytes, Pp – Parasitic plant, Th – Therophytes; Aph – Aphyllous, L – Leptophyll, Ma – Megaphyll, Me – Mesophyll, Mi – Microphyll, N – Nanophyll


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