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EVALUATION OF INDIGENOUS PLANT DIVERSITY OF KALABAGH, DISTRICT MIANWALI, PAKISTAN

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Abstract

Vegetation provides the main structure of the ecosystem, hence supporting different ecosystem services. Analysis of vegetation is very useful for identifying plant diversity patterns as it provides information about the processes that maintain the species diversity within the ecosystem. In this study indigenous vegetation and biochemical attributes of selected species in Kalabagh, Mianwali was determined. Five sites were selected for sampling on the basis of variation in soil composition, latitudinal and altitudinal. 38 species belonging to 19 families were present there. Poaceae was the most dominant family. *Acacia nilotica, Rhazya stricta*, *Trianthenum portulacastrum, Tribulus terrestris, Peganum hermala*, *Solanum incanum*, *Datura stramonium, Nerium indicum*, and *Oxalis corniculata*, grow there. Variation in distribution of plant species with soil was observed. *Rhazya stricta* was studied for its biochemical attributes.

Key words: Plant diversity, Kalabagh, District Mianwali, Pakistan.

Introduction

The inherent potential of biodiversity as a key resource for developing different products such as food, medicine, cosmetics and other natural products of commercial importance have now been ever more recognized. A nation success depends upon the ability of its people to convert the natural resources into wealth in an ecologically, economically sustainable manner with the help of science and technology (Pushpangadan *et al*., 2018). Plant diversity plays a crucial role in ensuring sustainability for all living organisms, contributing to a healthy ecosystem, biological resources, and social benefits (Siddiqui *et al*., 2016). Pakistan has diverse soil conditions, variety of climatic and ecological zones and unique floristic composition (Anon., 2005) and stands as a testament to the significance of plant diversity. All elements of six phytogeographic regions e.g., Mediterranean, Saharo-Sindian, Euro-Siberian, Irano-Turanian, Sino-Japanese and Indian have been found in vegetation of Pakistan (Shinwari, 2010).

Vegetation encompasses population, distribution, size, and the relative importance of plant species in a given area (Ali *et al*., 2016). Indigenous vegetation provides energy, food, shelter, and medicine to the local people (Rankoana, 2016). It is of pivotal importance to identify the local plant species of the area and gain knowledge on their occurrence, growing season, and the effect of climatic conditions and anthropogenic activities on vegetation (Wariss *et al*., 2013). The information pertaining to indigenous plants is, unfortunately, not recorded or well-maintained. Local people sustain indigenous plant communities through traditional practices and local management techniques. Local management practices play vital role in plant diversity conservation. Local names used by the people are the origins of traditional biodiversity. Local names, uses and management of indigenous vegetation by the local people refer to the traditional knowledge (Rankoana, 2016).

A set of climatological, ecological factors largely elevation, temperature, precipitation, soil type and vegetation cover affect distribution pattern of species. Habitat suitability, micro-climatic conditions and organism's association with its ecological niche have important role for providing information on dispersal and distribution patterns of different species. Changes in climate conditions and rain fall patterns coupled with global warming, mainly attributed to the anthropogenic activities, result in forest fragmentation, habitat destruction and local-scale extinctions of fauna and flora (Hamidi, 2017).

The vegetation of a particular ecosystem is affected by external factors especially from development activities (Bhatt & Bhat, 2016). Changes in climate conditions lead towards natural variation; plant species either move to suitable environment or die (Corlett & Westcott, 2013; Corlett, 2014). To globally conserve biodiversity, fifteen percent of the Earth's land surface has been legally protected. Protected areas have high diversity of plants (Coetzee *et al*., 2014). In situ conservation is being used to make sure viable plant populations of threatened species to persist in protected areas. Moreover, vulnerable species should have distinct species management plan (Heywood, 2015). Endangered species are grown in living collections in botanical garden arboreta and similar faculties through application of ex-situ conservation (Ensslin *et al*., 2015). For genetic optimization of living collections use of new molecular techniques can help in conservation (Wee *et al*., 2015). The objectives of this study were to comprehensively document the indigenous plant composition of Kalabagh, Mianwali district. The investigation aimed to identify and catalog the diversity of plant species present, providing a baseline understanding of the local flora.

Table 1. Sites location.

Sites	Coordinates	Elevation
Site 1	32º56’ 27” N-71º 30’13” E	629 ft.
Site 2	32º.966ºN “71.553º E	690 ft.
Site 3	32º40 N 71º54.55 E	629 ft.
Site 4	32º57 N 71º34 E	702 ft.
Site 5	32º35 N 71º32’37” E	650 ft.

Table 2. Meteorological data.

Month	Average temperature (ºC)	Average rain fall (mm)
January	13	160
February	17	130
March	23	170
April	36	40
May	41	0
June	47	12
July	49	220
August	41	270
September	35	0
October	27	70
November	22	10
December	20	90

Material and Methods

The survey was done to study indigenous plant species which grow at Kalabagh, Mianwali district, Punjab (Fig. 1). In these surveys, different plant species were observed and variation in species was recorded according to species type, growth patterns, and climate.

Sampling sites: Samples were collected from five different sites. Site selection was done based on difference in soil composition, vegetation type, latitude and altitude.

Location of sites: Latitude and altitude of sites was determined by using a Global Positioning System (GPS). Table 1 shows the coordinates and elevation of each site. Meteorological data were also collected for the whole year (Table 2).

Ecological study: Ecological studies were done by using a quadrat method.

Quadrat method: Sampling was done by using quadrate method. Quadrate used was a square frame, with size $1m^2$ (Zameer *et al*., 2015). Ten quadrates were thrown at each site randomly and sampling was done. Specimens of plant species encountered at each site during the study period were collected and herbarium vouchers were prepared, identified and stored in the lab, department of Botany, University of Sargodha. Ten randomly selected quadrates were taken.

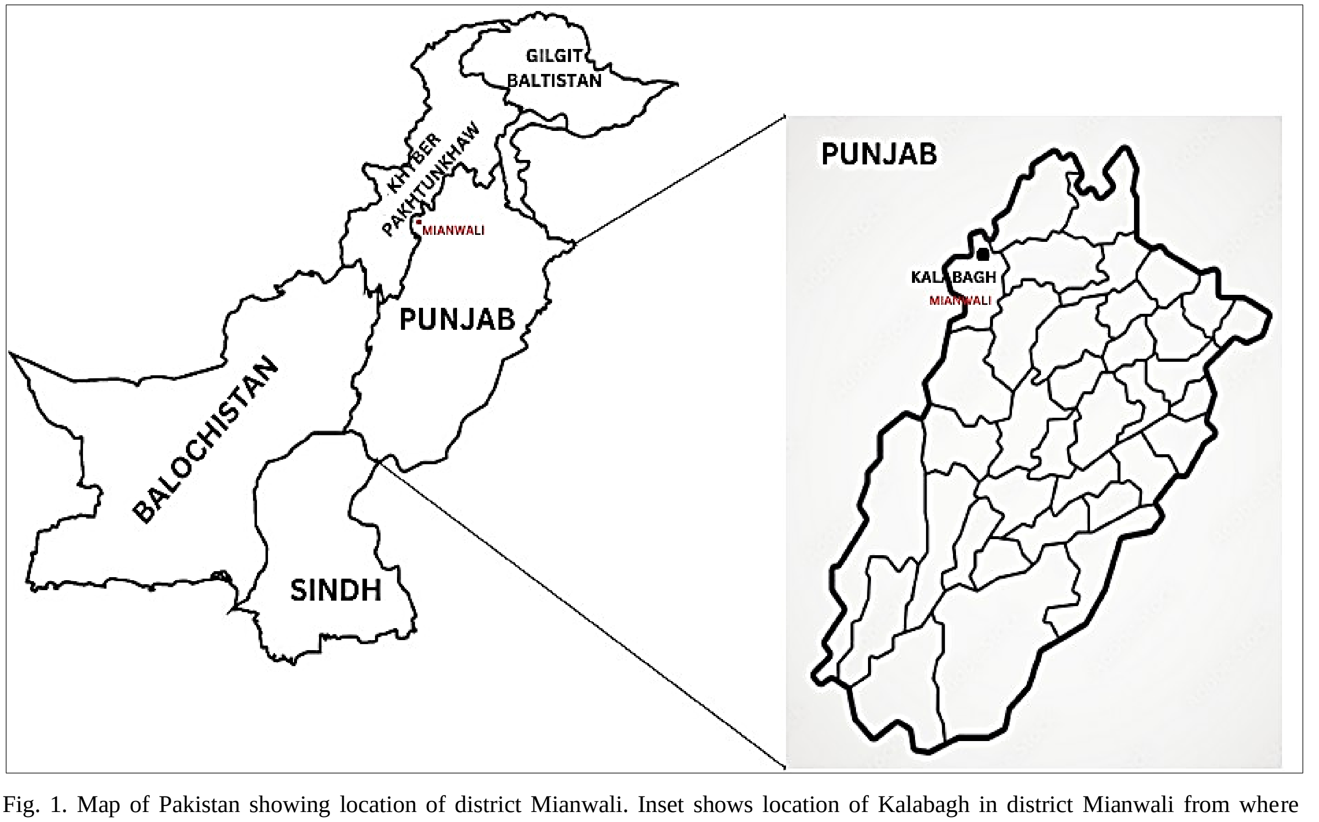

Fig. 1. Map of Pakistan showing location of district Mianwali. Inset shows location of Kalabagh in district Mianwali from where sampling for determination of indigenous species was done.

The following formulae were used to study different parameters (Ahmad *et al*., 2007).

$$\text{Frequency \%} = \frac{\text{Number of quadrates in which a species occurred}}{\text{Total number of quadrates taken}} \times 100$$

$$\text{Density \%} = \frac{\text{Total number of individuals of a species in a quadrate}}{\text{Total number of individuals of all the species in a quadrate}} \times 100$$

$$\text{Coverage/Dominance \%} = \frac{\text{Area covered by a species in a quadrate}}{\text{Total area covered by all the species}} \times 100$$

$$\text{Relative frequency \%} = \frac{\text{Frequency value of a particular species}}{\text{Total frequency values for all the species}} \times 100$$

$$\text{Relative density \%} = \frac{\text{Density of a particular species in a site}}{\text{Total density for all the species in that site}} \times 100$$

$$\text{Coverage/Dominance \%} = \frac{\text{Coverage/dominance of a particular species}}{\text{Total coverage/dominance for all the species}} \times 100$$

Importance value = Relative density + Relative frequency +Relative coverage

Sample collection: Soil sampling was done at each of the five sites. Ten samples were taken randomly from each site. Samples Z scheme was used for soil sampling. 3 replicates were taken from each site.

Sample preparation: Soil sample was made by mixing 3 replicates from homogenized soil. To study % saturation paste of dry sample was made.

Soil analysis: Soil texture was determined by Hygrometer method (Dewis & Freitas 1970). Electrical conductivity, pH and ions were checked according to Rhoades (1982) and Jackson (1962), (Table 3).

Results

Indigenous vegetation: Survey on indigenous vegetation of Kalabagh was done. Survey showed that the a total of thirty eight (38) plant species grew there. Name of each plant along with their local names is mentioned in Table 4.

Frequency % of plant species: At site 1, frequency (%) ranged from minimum 6% (*Salvadora oleoides*) and (*Fagonia indica*) to maximum 53% (*Convulvulus arvensis*). At site 2, frequency (%) ranged from minimum 6% (*Acacia nilotica*) and (*Salvadora oleiodes*) to 93% (*Sacchrum munja*). At site 3, frequency (%) ranged from minimum 6% (*Datura stramonium*) to maximum 53% (*Trianthenum portulacastrum*). At site 4, frequency (%) ranged from minimum 6% *(Nerium indicum*) to maximum 60% *(Setaria glauca*). At site 5, frequency (%) ranged from minimum 6% (*Acacia nilotica*) to maximum 93% (*Desmotachya bipinnata*) (Fig. 2).

Density (%) of plant species: At site 1, density (%) ranged from minimum 6% (*Fagonia indica*) to maximum 513% (*Rhazya stricta*). At site 2, density (%) ranged from the minimum 6% (*Sacchrum munja*) to maximum 226% (*Peganum hermala*). At site 3, density (%) ranged from the minimum 6% (*Tamarix aphylla*) to maximum 213% (*Peganum hermala*). At site 4, density (%) ranged from the minimum 6% (*Ziziphus maurtiana*) to maximum 113% (*Peganum hermala* and *Medicago Polymorpha*). At site 5, density (%) ranged from the minimum 6% (*Tamarix aphylla*) to maximum 160% (*Solanum inacum*) (Fig. 3).

Coverage (%) of plant species: At site 1, coverage (% age) ranged from minimum 6% (*Medicago Polymorpha*) to maximum 400 % (*Acacia nilotica*). At site 2, coverage (% age) ranged from minimum 6% (*Rhazya stricta* and *Sochus asper*) to maximum 400 % (*Acacia nilotica*). At site 3, coverage (% age) ranged from minimum 6% (*Ziziphus maurtiana*) to maximum 400% (*Salvadora oleoides*). At site 4, coverage (% age) ranged from minimum 6% (*Dicanthinum annulatum*) to maximum 400% (*Salvadora oleoides*). At site 5, coverage (% age) ranged from minimum 6% (*Convululus arvensis*) to maximum 80% (*Desmotachya bipinnnata*) (Fig. 4).

Relative density (%) of plant species: At site 1, the relative density (%) ranged from minimum 1% (*Peganum hermala* and *Fagonia indica*) to maximum 89% (*Rhazya stricta*). At site 2, the relative density (%) ranged from minimum 9% (*Sacchrum munja*) to maximum 39% (*Peganum hermala*). At site 3, the relative density (%) ranged from minimum 1% (*Tamarix aphylla* and *Sacchrum spontaneum*) to maximum 55% *(Rhazya stricta*). At site 4, the relative density (%) ranged from minimum 1.15% (*Trianthenum portuclastrum* and *Sonchus asper*) to maximum 17% (*Acacia nilotica*). At site 5, the relative density (%) ranged from minimum 1.15% (*Tamarix aphylla* and *Erigeron bonariensis*) to maximum 86% (*Calotropis procera*) (Fig. 5).

Relative cover (%) of plant species: At site 1, relative cover (%) ranged from minimum 7% (*Fagonia indica* and *Salvadora oleoides*) to maximum 92% (*Tecomela undulata*). At site 2, relative cover (%) ranged from minimum 7% (*Acacia nilotica*) to maximum 99% (*Sacchrum spontaneum*). At site 3, relative cover (%) ranged from minimum 7% (*Cynodon dactylon*) to 56 % (*Trianthenum portuclastrum*). At site 4, relative cover (%) ranged from minimum 7% (*Nerium indicum*) to 63% (*Medicago polymorpha*). At site 5, relative cover (%) ranged from minimum 7% (*Acacia nilotica*) to 99% (*Tecomela undulata*) to minimum 7% (*Accacia nilotica*) (Fig. 6).

Table 3. Physico-chemical properties of soil.

	Site 1	Site 2	Site 3	Site 4	Site 5
pH	8.2	8.2	8.2	8.1	8.0
E.C $mScm^{-1}$	2.48	2.95	3.76	3.08	2.71
Saturation%	38	38	38	38	38
Organic matter %	0.69	0.83	0.76	0.69	0.76
Texture	Loam	Loam	Loam	Loam	Loam
Potassium $mgkg^{-1}$	178	142	168	156	182
Phosphorus $mgkg^{-1}$	7.1	7.2	7.0	7.0	7.3

Table 4. Indigenous vegetation of Kalabagh.

S. No.	Species name	Local name	Family name
1.	*Acacia nilotica*	Phulai	Fabaceae
2.	*Salvadora oeloides* Decne	Peelu	Salvadoraceae
3.	*Tamarix aphylla* (L.) Karst.	Athel	Tamiaraceae
4.	*Ziziphus numularia* (Burm.f.) Wight & Arn.	Malaa	Rhamnaceae
5.	*Datura stramonium* L.	Datura	Solanaceae
6.	*Fagonia indica* L.	Damah	Zygophyllaceae
7.	*Justicia adhatoda* L.	Vahekar	Acanthaceae
8.	*Melilotus indica* (L.) All.	Senji	Fabaceae
9.	*Nerium indicum* L.	Kner	Apocynaceae
10.	*Oxalis corniculata* L.	Khati mithi	Oxalidaceae
11.	*Peganum hermala* L.	Harmal	Nitraricaeae
12.	*Solanum incanum* L.,	Mahori	Solanceae
13.	*Solanum nigrum* L.	Kach mach	Solanceae
14.	*Tribulus terrestris* L.	Bhakra	Zygophyllaceae
15.	*Cynodon dactylon* (L.) Pers.	Khabal	Poaceae
16.	*Cyperus rotundus* L.	Deela	Cyperaceae
17.	*Saccharrum munja* Roxb.	Sur kanda	Poaceae
18.	*Saccharrum spontaneum* L.	Kai	Poaceae
19.	*Desmostachya bipinnata* (L.) Stapf	Darbha Ghas	Poaceae
20.	*Convolvulus arvensis* L.	Werhi	Convulvulaceae
21.	*Poa annua* L.	Piazi	Poaceae
22.	*Cressa cratica* L.	Rudanti	Convulvulaceae
23.	*Malcolmia* W.T. Aiton		Brassicaceae
24.	*Crozophora tinctoria* (L.) A. Juss	Uth chara	Euphorbiaceae
25.	*Sonchus asper* (L.) Hill	Dudhi	Asteraceae
26.	*Setlaria media* (L.) Vill.	Gandal	Caryophyllaceae
27.	*Trianthenum portulacastrum* L.	It Sit	Aizoaceae
28.	*Erigeron bonariensis* L.	Baboona	Asteraceae
29.	*Calotropis procera* (Aiton). W.T. Aiton	Ak	Apocynaceae
30.	*Rhazya stricta* Dcene	Viran	Apocynaceae
31.	*Astragulus* sp.	Katira	Fabaceae
32.	*Imperata cylendrica* (L.) P. Beauv.	Dhab	Poaceae
33.	*Dicantinum annulatum* (Forssk). Stapf	Marval	Poaceae
34.	*Medicago polymoprpha* L.	Maina	Fabaceae
35.	*Setaria galuca* (L.) P. Beauv	Lommar	Poaceae
36.	*Achyranthes aspera* L.	Charchitta	Amranthaceae
37.	*Aristida adscensionis* L.	Gandhi	Poaceae
38.	*Tecomela undulata* (Sm). Seem	Rohida	Bignoniaceae

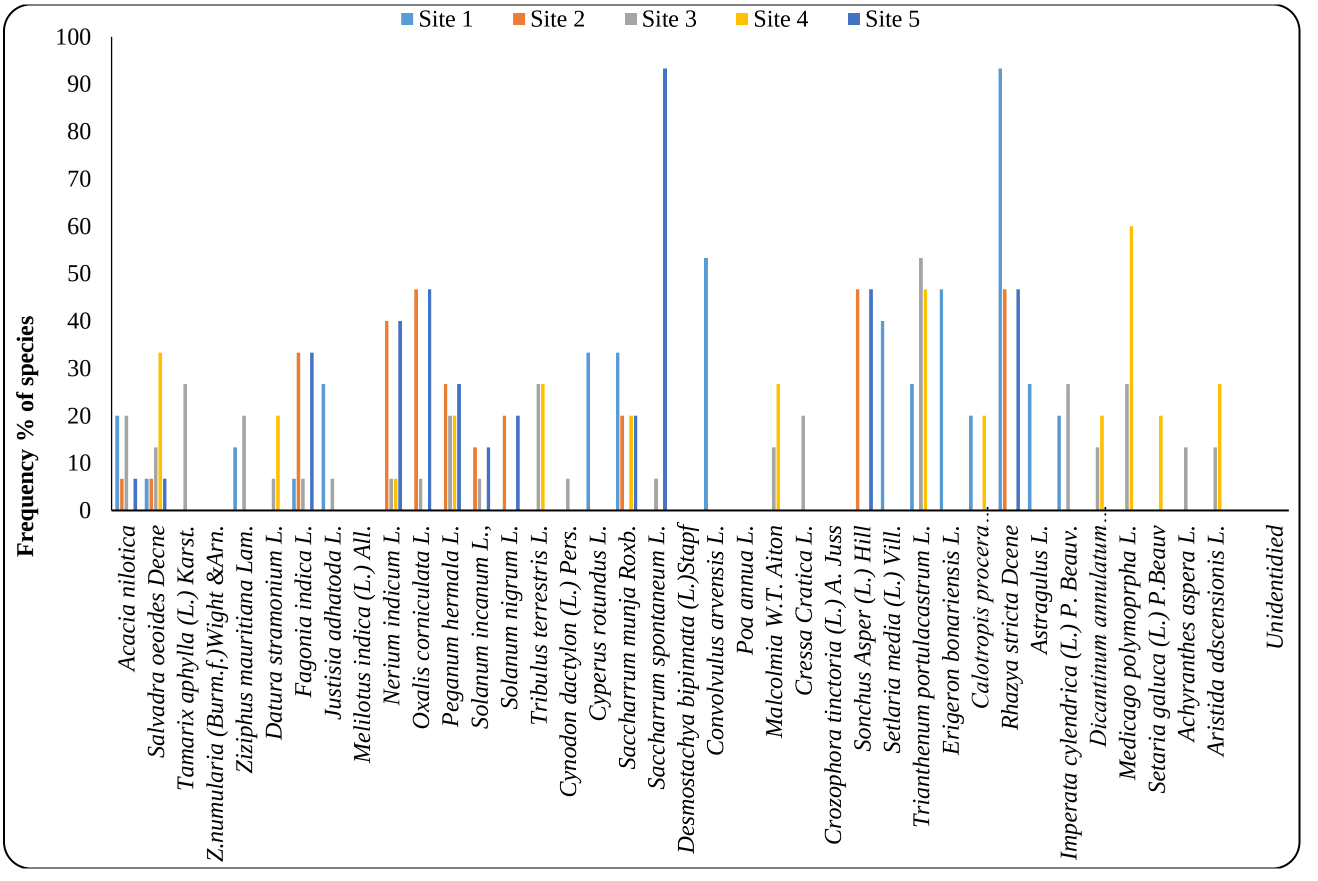

Fig. 2. Frequency (%) of plant species at different sites of Kalabagh, Mianwali.

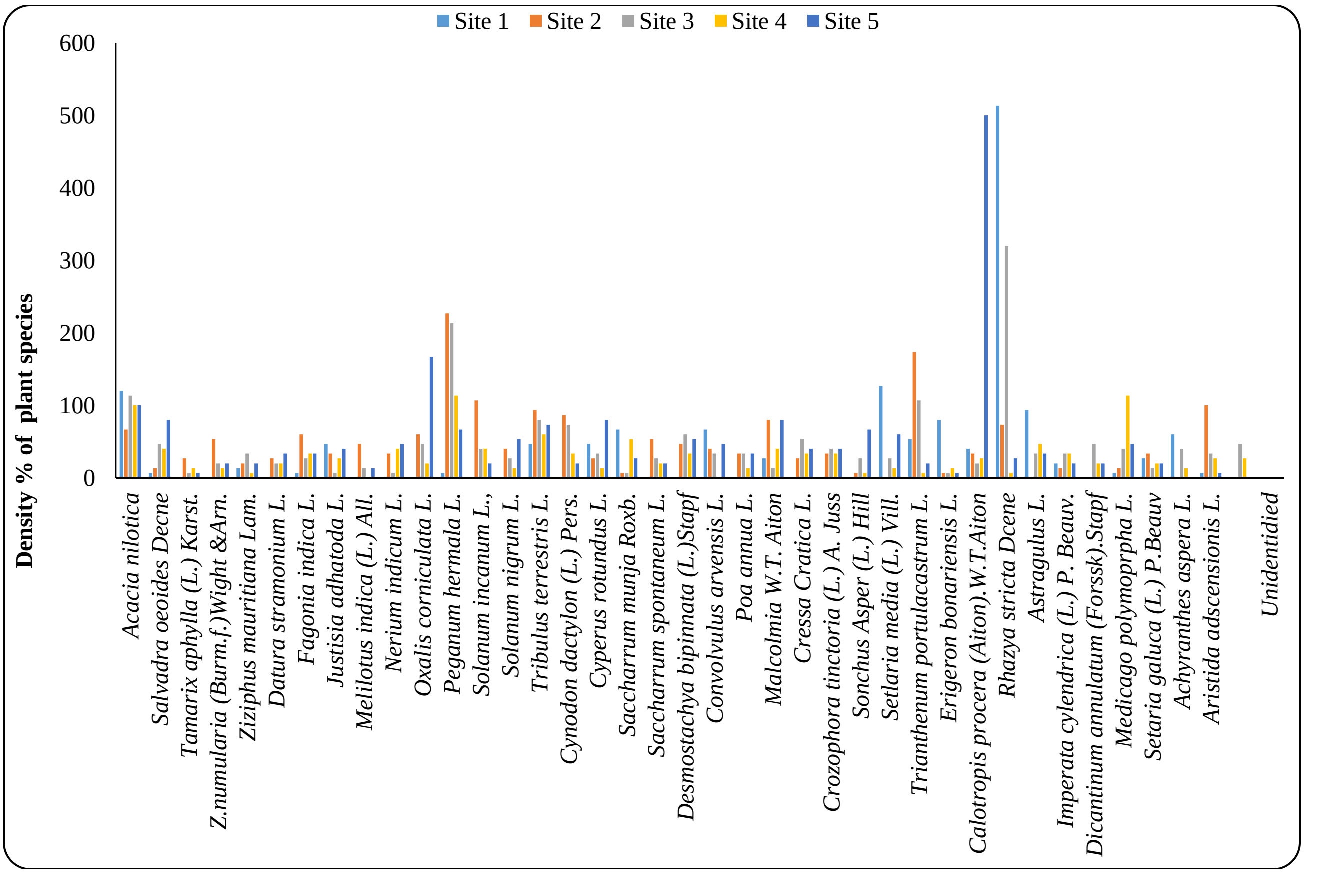

Fig. 3. Density (%) of plant species at different sites of Kalabagh, Mianwali.

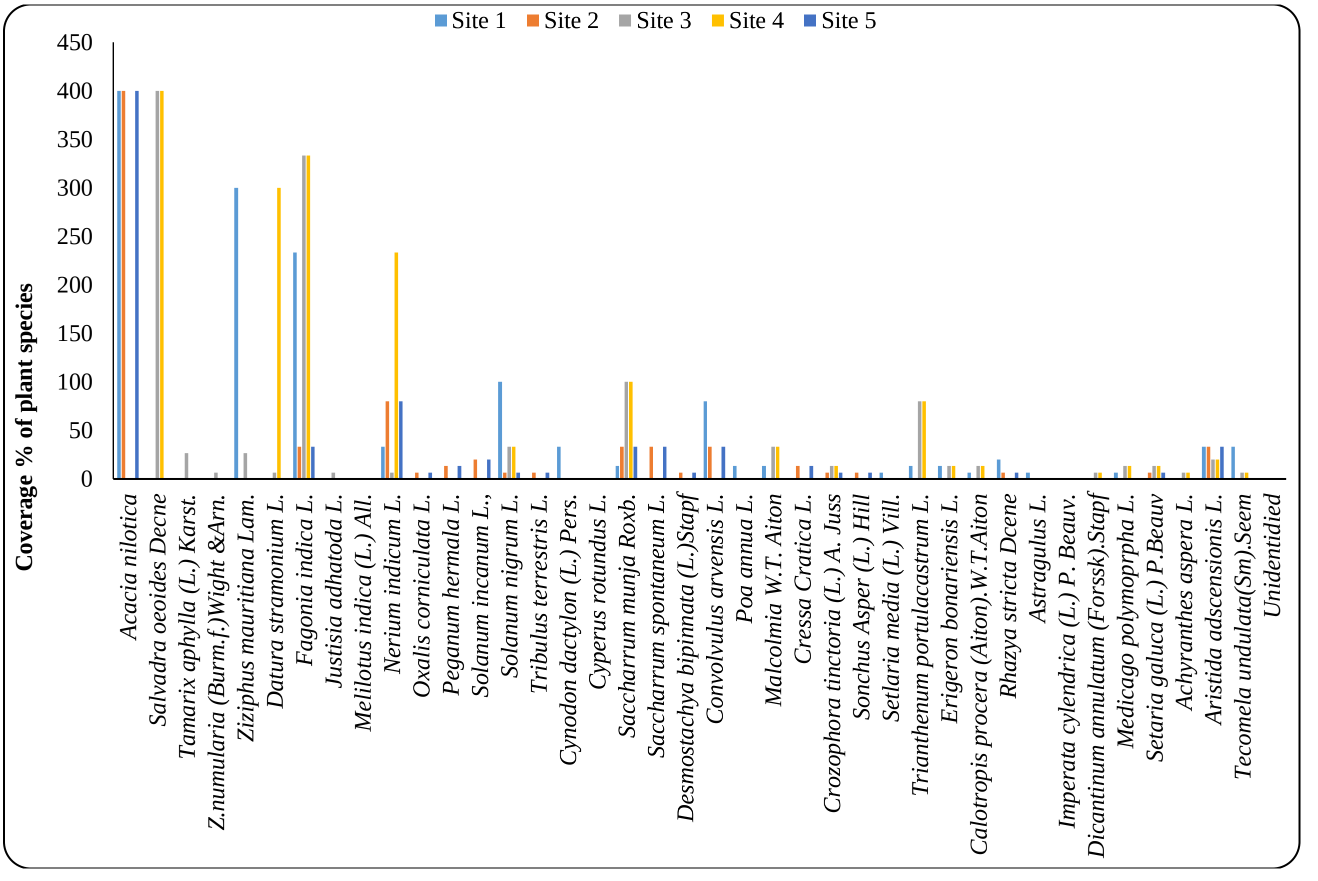

Fig. 4. Coverage (%) of plant species at different sites of Kalabagh, Mianwali.

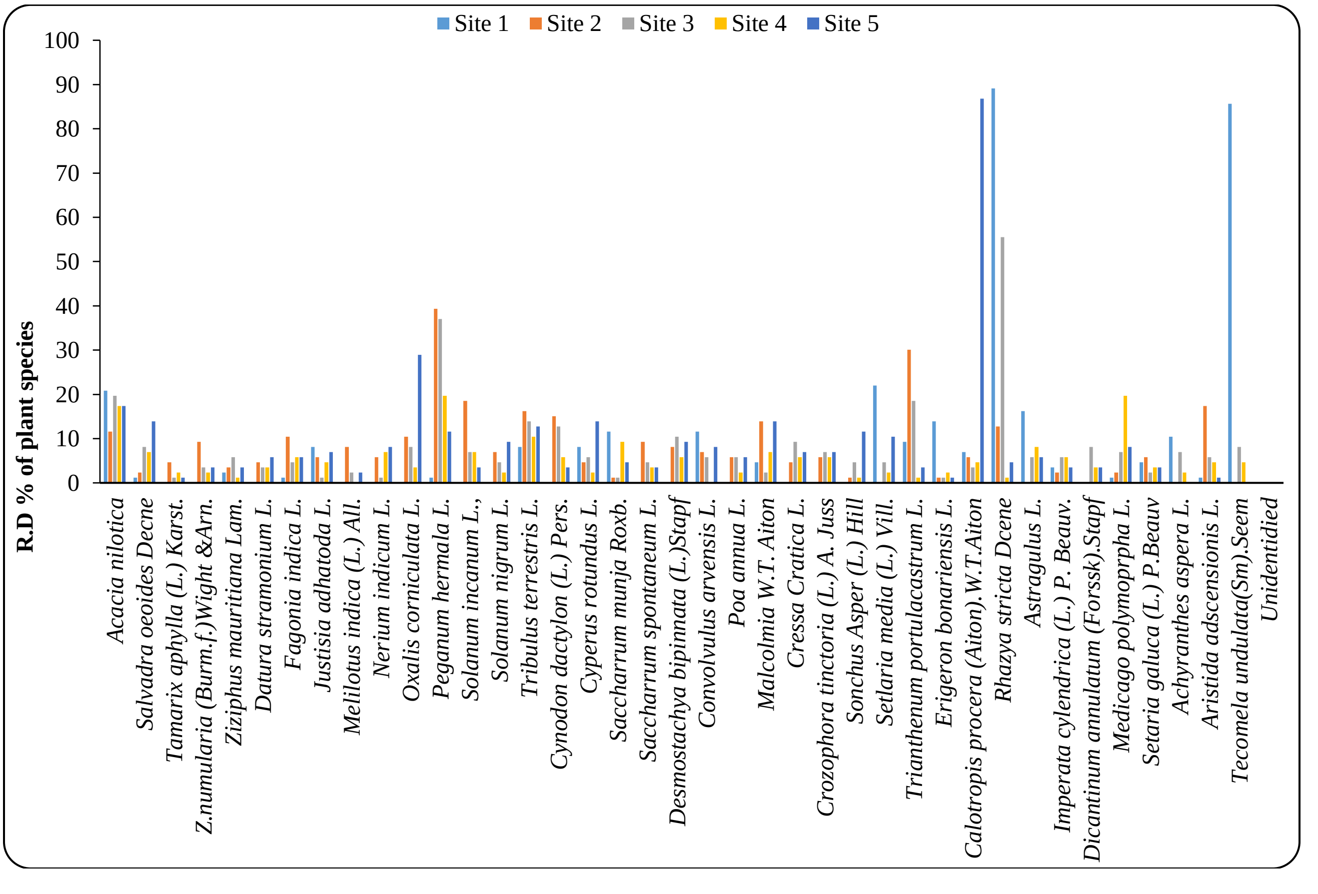

Fig. 5. Relative density % of plant species at different sites of Kalabagh, Mianwali.

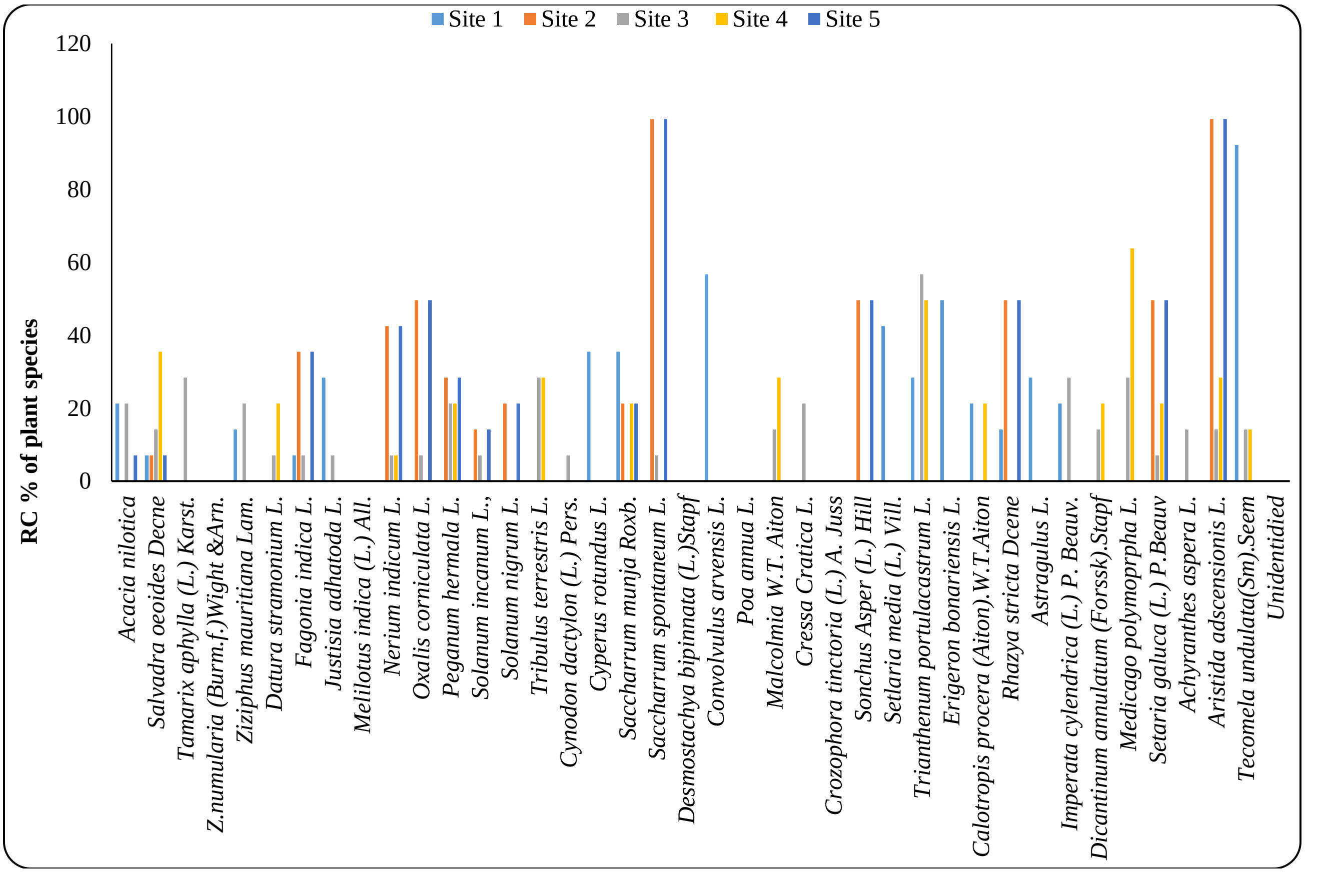

Fig. 6. Coverage (%) of plant species at different sites of Kalabagh Mianwali.

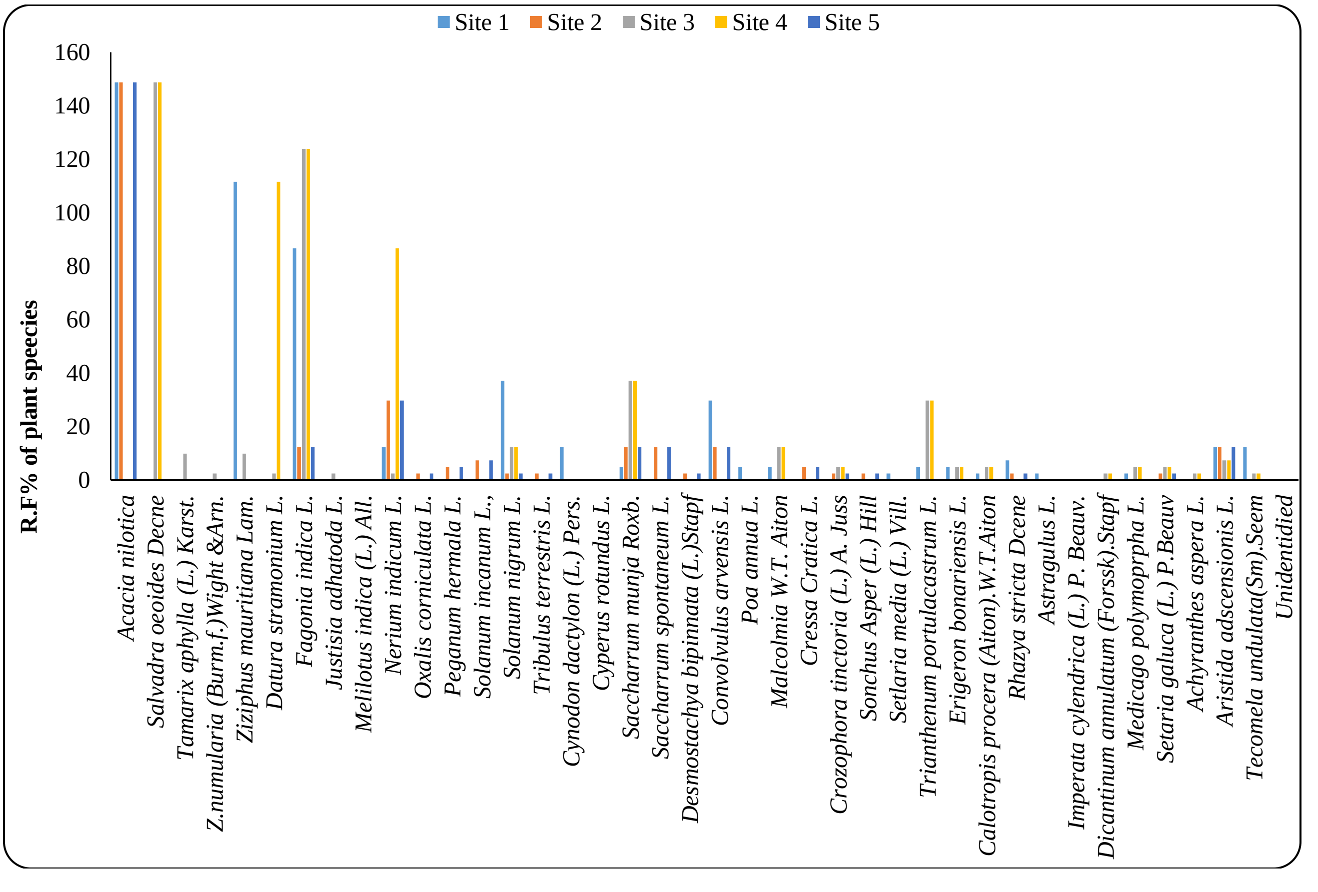

Fig. 7. Relative frequency (%) of plant species at different sites of Kalabagh, Mianwali.

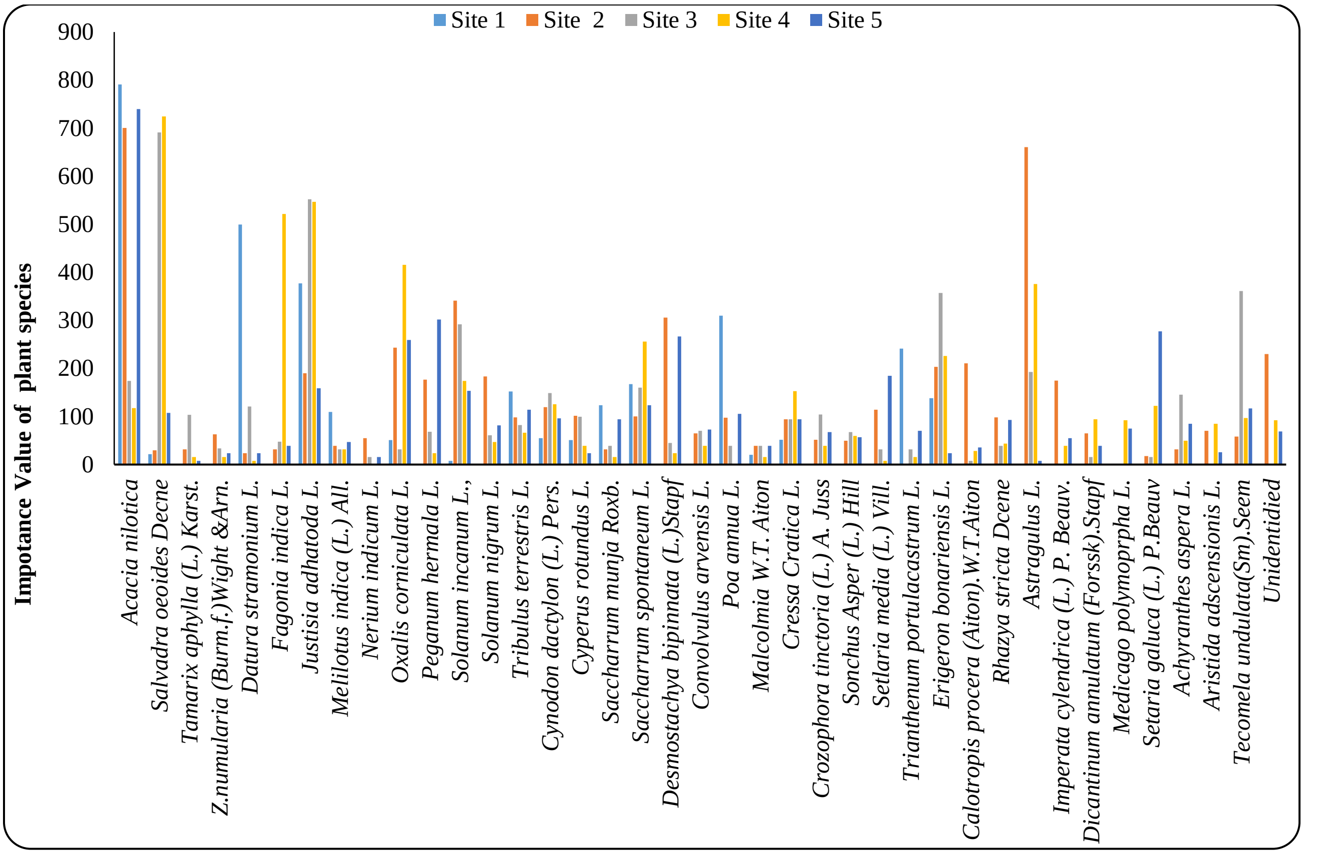

Fig. 8. Importance value (%) of plant species at different sites of Kalabagh, Mianwali.

Relative frequency (%) of plant species at different sites: At site 1, relative frequency (%) ranged from minimum 2% (*Setlaria media*) to maximum 148% (*Accacia nilotica*), whereas *Fagonia indica* and *Ziziphus maurtiana* had 86% and 111% relative frequencies respectively. At site 2, relative frequency (%) ranged from minimum 2% (*Trianthenum portuclastrum*) to maximum 148% (*Accacia nilotica*). At site 3, relative frequency (%) ranged from minimum 2% (*Dicanthimum annulatum*) to maximum 148% (*Salvadora oleoides*). At site 4, relative frequency (%) ranged from minimum 2% (*Tecomela undulata*) to maximum 148% (*Salvadora oleoides*). At site 4, relative frequency (%) ranged from minimum 2% (*Achyranthes aspara*) to maximum 148% (*Accacia nilotica*) (Fig. 7).

Importance value (%) of plant species at different sites: At site 1, importance value (%) ranged from minimum 7% *(Peganum hermala*) to maximum 790% (*Acacia nilotica*). At site 2, importance value (%) ranged from minimum 7% (*Calotropis procera*) to maximum 700% (*Acacia nilotica*). At site 3, importance value (%) ranged from minimum 15% (*Melilotus indicus*) to maximum 690% (*Salvadora oleoides*). At site 4, importance value (%) ranged from minimum minimum 7% (*Rhazya stricta*) to maximum 415% (*Acacia nilotica*). At site 5, importance value (%) ranged from minimum 7% (*Calotropis procera*) to maximum 739% (*Acacia nilotica*) (Fig. 8).

Discussion

Soil is a complex mixture of minerals and the organic products of living organisms. It provides habitat and support to small array of creatures from bacteria and fungi to mites, earth worms and plants (Aber *et al*., 2000).

Soil saturation was 38% for all sites. The present results for soil saturation were higher than the results reported by Iqbal *et al*., (2016) and lower than the values reported by Zameer *et al*., (2015). Saturated soil contains the maximum amount of water possible. All the pores are filled with water in saturated soils (Six *et al*., 2002).

Soil electrical conductivity (EC) for all sites was maximum at site 3 (3.76mS/cm) and minimum at site 5 (2.71mS/cm). Current results for EC were in accordance with the values reported by Fadl *et al*., (2015) and higher than the results reported by Ali & Malik (2010). Soil EC for all sites was less than 4 mS/cm. Soil with EC below than 4 mS/cm is considered as the good soil for yield and growth of plants (Crowin & Lesch, 2005).

Soil pH for all sites was 8 with little variation. The present values for soil pH were higher than the results reported by Ilyas *et al*., (2012) and in accordance with the results reported by Fadl *et al*., (2015). Plant nutrient availability is affected by soil pH. The optimum range for most plants is between 5.5 and 7.0 (Perry, 2012).

Soil organic matter (SOM) for all sites was the maximum at site 2 and the minimum at site 4. Khan *et al*., (2016) reported higher values than present investigation for soil organic matter. Present investigations for SOM were in accordance with the results reported by Zameer *et al*., (2015). SOM exerts numerous positive effects on soil physical and chemical properties enhancing the soil’s capacity to provide regulatory ecosystem services (Brady & Weil, 2002).

The amount of available K was maximum at site 5(182 mg/kg) and minimum at site 2 (142 mg/kg). Present results were higher than the values reported by Ahmad *et al*., (2007). Current results were lower than the values reported by Ilyas *et al*., (2015). Lack of potassium causes stunted plants with small branches and little vigour (Tucher, 1999).

The amount of available P was 7.2 mg/kg. Results in present investigation were higher than the values reported by IIyas *et al*., (2015). Current results were lower than the results reported by Raja *et al*., (2014). Phosphorous as an essential nutrient is necessary for plant growth and reproduction (Freeman, 2008).

Vegetation analysis showed that herbs and shrubs dominated the area. *Fagonia indica*, *Salvadora oleoides*, *Rhazya stricta*, *Acacia nilotica* grew there. These species had high field capacity, which helps to retain more moisture even without heavy rains. Naz *et al*., (2010) reported that *Fagonia indica* confined in the Cholistan desert. *Peganum harmala* showed less distribution as this species found in areas with high moisture and dry conditions are a threat for this species. High amounts of macronutrients are important for growth of herbs (Ahmed *et al*., 2011). Among the recorded species from this region some were extremely rare and poorly known, e.g., *Calotropis procera*, *Aerva javanica*, *Solanum nigrum* as reported by Al-Turki & Al-Qlayan (2003).

Number of plant species was high at site 5 and low at site 4. This may be due to high availability of nutrients and low electrical conductivity. Electric conductivity is an important ecological gradient affecting vegetation distribution (Farrag, 2012).

Convolvulus species are very sensitive to grazing whereas grasses are generally resistant to over-grazing (Naz *et al*., 2010). In a previous study, overgrazing was identified as threat to a number of plant species in the area, as the people were poor and depended upon animals economically (Iqbal *et al*., 2016). Overharvesting of herbaceous plants had become a severe threat to herbs' plant diversity. Forest resources play a crucial role in rural livelihoods and are a primary factor contributing to plant loss (Iqbal *et al*., 2016).

Environmental factors affect not only the growth of native plant species, but also the distributional pattern of plant species significantly. Anthropogenic activities play important role for community composition, structure and distributional pattern as more stress tolerant species replace the sensitive ones (Iqbal *et al*., 2016).

Conclusion

From present study it was concluded that *Acacia nilotica*, *Rhazya stricta Dcene*, *Trianthenum portulacastrum*, *Tribulus terrestris*, *Peganum hermala*, *Solanum incanum*, *Datura stramonium* and *Oxalis corniculata* grew commonly at Kalabagh. 38 plant species belonging to 19 families were identified. Poaceae was the most dominant family. Variation in vegetation with reference to soil physico-chemical properties was observed at all sites. Vegetation had great threats of overgrazing and deforestation. The research would prove useful in assessing the conservation status of the identified plants and proposing strategies for sustainable management to preserve the unique botanical heritage of the Kalabagh.

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