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DIVERSITY OF HALOPHYTES GROWING IN THE UNIVERSITY OF PESHAWAR BOTANICAL GARDEN, KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

The present study was conducted to investigate the Halophytic Biodiversity of the University of Peshawar Botanical Garden. The study revealed 37 halophytic plant species belonging to 34 genera and 18 families. Four families were of monocotyledons and 14 families were of Dicotyledons. The leading family was Poaceae with 10 species (27.03%), followed by Chenopodiaceae with 4 species (10.81%) and Papilionaceae with 3 species (8.81%). The remaining families consisted of less than 3 species each. The Halo-physiotypic classification revealed that Xerohalophytes were dominant with 12 (32.43%) species, Hydrohalophytes 9 (24.32%), Psammophytes6 (16.22%), Weedy 5 (13.51%), Xerohalophyte 3(8.11%), while Chasmophytes and Phrea with 1(2.70%) species each. The Electric conductivity (EC) of the soil ranges from 6.9 to 15.8 dS/m and the soil texture varied from loamy sand to clay. On the basis of biological spectrum the Thererophytes and Nanophanerophytes were dominant with 13(35.14%) species each, followed by Chamaephytes 5 (13.51%) species, Microphanerophytes and Mesophanerophytes 2(5.41%) species each and Megaphanerophytes sand Hemicryptophytes with 1(2.70%) species each. Leaf size spectrum was dominated by Nanophylls with 14(37.84%) species, followed by Microphylls 11(29.73%), Leptophylls 6(16.21%), Macrophylls 3(8.12%), Mesophylls 2(5.41%) and Megaphylls with 1(2.70%) species. Abundance status indicated that 21(56.76%) were frequent followed by dominant and rare with 8(21.62%) species. Phenologically 27(72.97%) species were in reproductive and 10(27.03%) were in vegetative stages.

Key words: Halophytes, Biodiversity, Xerohalophytes, Life-form, Phenology, Botanical Garden.

INTRODUCTION

The University of Peshawar Botanical Garden is situated in District Nowshera and lies between $71^0 43^/$ E to $71^0 44^/$ E longitudes and $34^0 15^/$ N to $34^0 31^/$ N latitudes at an altitude of 290 msl. It is bounded on the South by Cherat hills behind Azakhel village, on North by GT Road, on East by Pirpai and on the West by Pabbi town. The total area occupied by the Botanical Garden is 83 acres. Botanical Garden is situated in semi-arid climatic region (hot during summer and cold during winter). The Soils which has electrical conductivity of the saturated paste extract (EC) is 4 dS m −1 or more is known as SALINE and those plant species that has capacity to grow, tolerate and complete their life cycle in these habitats are called halophytes (Ungar, 1991 and Munns and Tester, 2008). Only 2% of world terrestrial plant diversity is represented by halophytes and half of the higher plant families have halophytes in which Chenopodiaceae has the largest 550 halophyte species (Aslam *et al.*, 2011). The salinity and water logging are twin problems and goes side by side. A saline soil has more concentration of Chlorides and Sulphates of Na^+, Ca^+ and Mg^+. In a highly saline soil Na^+ is more abundant than other salts. The total salt-affected area in Pakistan is 5.8 million Hectares. Out of this, 3.1 million Hectares is in the canal-commanded area and potentially valuable land if rehabilitated. Within the canal command area, 1.96 million ha has been abandoned due to severe salinity and sodicity (Chaudhri *et al.*, 1978). The total 2200 halophytic species are reported worldwide, Pakistan alone has about 410 halophytic plant species (Khan and Qaiser, 2006). Salt-affected areas with the associated problem of water logging (water table within 1 m) covers about 1.16 million Hectares (Ahmad and Chaudhry, 1988). In the North West Frontier Province (NWFP) 0.514 million Hectares are in the grip of salinity. The main centres are the Peshawar valley and D.I. Khan District. Halophytes are found in a range of environmental conditions depending on their ability to tolerate various combinations of salts in the substrate (Chaudhri *et a1*., 1978).

Research has been carried out by various scientists around the world on various aspects of halophytes and a global database has been prepared with emphasis on economic importance, use of forge halophytes, salt tolerance and crop potential (Aronson, 1989; Qureshi *et al*., 1993; Glenn and Brown, 1999). Similarly, various aspects of halophytes have been explored by various workers in Pakistan i.e. (Sarir *et al.*, 1984; Hussain and Gul, 1991; Khan, 2003; Bakht *et al*., 2007; Marwat *et al*., 2013). Some floristic work has been carried out by Shah and Hussain (2007) reported 42 plant species of 31 families and established 6 plant communities in the waterlogged and saline habitats in Chamkani and Peshawar. Hadi *et al*. (2009) reported 30 weeds species of 14 families from rice fields of Botanical Garden. Poaceae was dominant family with 7 species while therophytes and nanophylls were the leading life-form and leaf-size classes. Shah and Hussain (2011) reported 23 species of weeds from sunflower crops of University of Peshawar Botanical Garden and Hussain *et al.* (2009) mentioned 62 species of weeds including 15 monocots and one pteridophyte of 24 families for the first time as weeds of wheat in the University of Peshawar Botanical Garden

but no detailed account of the halophytic angiosperms are available. Therefore, the present study was conducted to highlight floristic account of halophytic plant species of the research area. As the present report is the first ever record of halophytes found in the Botanical Garden, besides, adding knowledge of the existing halophytic diversity, it will serve as first hand base line data for future scientists working on the management and dynamics of halophytes in Botanical Garden and its adjoining areas.

MATERIALS AND METHODS

The field study was conducted during summer 2014 in the University of Peshawar Botanical Garden, Azakhel. Diverse information regarding the halophytic species was documented on the spot in the field note book. Life form classification and leaf size determination was carried out as per standard classes of Raunkiaer (1934) and Hussain (1989). Abundance status and phenology for all species were also noted. The already available literature was consulted for Halo-physiotypic classification, determination and confirmation was carried out with the help of Computerized Global Database of Halophytes and Halophytes of Pakistan (Aronson, 1989; Khan and Qaiser, 2006). For determination of Electric Conductivity (EC) soil samples were collected from the bottom of each species and 10 g of each soil sample was dissolved into 100 ml pure water. The soil solution was mixed well and the electric conductivity (EC) of each soil sample was measured with Electrical Conductivity Meter (EC meter). The soil texture was determined through Particle Size Analysis (PSA) adapted from McDonald *et al.* (1998). The plant specimens were collected, pressed, documented, dried, identified and mounted on standard herbarium sheets. The identification was carried out with the help of available literature i.e. (Qureshi and Khan, 1965-1967; Qureshi and Khan, 1971; Nasir and Ali, 1970-1989; Ali and Nasir, 1989-1991; Ali and Qaiser, 1993-2014). The voucher specimens were deposited in the Herbarium of Centre of Plant Biodiversity and Botanical Garden, University of Peshawar (UPBG).

RESULTS AND DISCUSSION

This quantitative floristic survey was conducted for the first time in the University of PeshawarBotanical Garden, Azakhel. Based on the previous findings during research work regarding the saline and waterlogged habitat of the University of Peshawar Botanical Garden the halophytic species were collected and identified. The Halo-physiotypic classification was carried out after Khan and Qaiser (2006) and the plants were divided in to various categories based on their habitat. The major plant type groups were Hydrohalophytes (present in salt marshes), Xerohalophyte (salt desert species), Psammophytes (sand loving plants found on littoral or inland sand dunes), Xerohalophytes (desert species suspected as halophytes), Chasmophytes (cliff-dwelling species), Weedy (fugitive species) and Phrea (fibers species). Photographs of some of the common species were also taken i.e. *Calotropis procera, Imperata cylindrica, Suaeda fruticosa* and *Tamarix aphylla* and (Plates 1-4). The *Suaeda fruticosa* soil was with highest EC value of 15.8 dS/m, followed by *Phragmites karka and Tamarix aphylla* with EC values of 13.6 and 12.6 dS/m, respectively showing that they are the most salinity tolerant species. The Electric conductivity (EC) is the measure of salinity of soil (Munns and Tester, 2008). According to previous studies it is evident that Halophytes relay on inorganic cations i.e. Na^+ and K^+ for its osmotic adjustment to salinity (Smith *et al*., 1997).

Previous studies revealed that there may be two distinct groups of Halophytes, high-sodium physiotype represented by Chenopodiaceae and low-sodium physiotype represented by Halophytic members of Poaceae (Albert, 1975). The difference between these two groups is based on Na^+ and K^+ ratios. The high-sodium physiotype maintains value between 10 and 30 and the low-sodium between 2 and 3. The high and low-sodium physiotype evolution may be a response of the plant to the salinity condition and ion accumulation. The tolerance of plants to salinity relies on Na^+ for osmotic adjustment, while tolerance to drought relies on K^+ uptake and accumulation for osmotic adjustment (Glen *et al*., 1992). The soil pH of the University of Peshawar Botanical Garden is ranging from 8.4 to 8.8, which is an indication to high-sodium concentration. Similarly, it is also evident from the pH and EC that the soil of Botanical Garden is in favour of the growth of halophytic species. The Halophytic flora is represented by members of Chenopodiaceae e.g. *Suaeda fruticosa* (high-sodium physiotype) and members of Poaceae e.g. *Desmostachya bipinnata* and *Phragmites karka* (low-sodium physiotype).

During the present research 37 species of 34 genera belonging to 18 families were collected (Table 1). Among these monocots are represented by 13 species belonging to 13 genera and 4 families, while dicots were represented by 24 species belonging to 21 genera and 14 families. Poaceae was the largest family that contributed 10 species (27.03%), followed by Chenopodiaceae with 4species (10.81%), Papilionaceae with 3 species (8.11%), Asteraceae, Euphorbiaceae, Plantaginaceae, Solanaceae and Verbenaceae with 2 species (5.41%) each (Fig. 1). The remaining 10 families have 1 species each (2.70%) representation (Table 1). Life form was recorded and plants were divided into different life form classes. Biological spectrum was formed when all the plant species were classified into life

Table 1. Floristic composition, plant type, biological spectra and abundance status, phenology, electric conductivity (EC) and soil texture of Halophytic plants species found in University of Peshawar, Botanical Garden, Pakistan.

S #	Plant species	Plant Type	Life form	Leaf size	Abundance status	Phenology	EC (dS/m)	Soil texture
A.	**Monocotyledons**							
1.	**Arecaceae**							
	1. *Phoenix dactylifera* L.	Hyphal.	MegP	Meg	R	V	10.3	Silty clay loam
2.	**Cyperaceae**							
	2. *Cyperus rotundus* L.	Hyphal.	NP	Mic	F	R	8.9	Clay loam
3.	**Poaceae**							
	3. *Cynodon dactylon* (L.) Pers.	Weedy	H	L	D	R	9.5	Silty loam
	4. *Dactyloctenium aegyptium* (L.) Willd.	Weedy	Th	Mic	F	R	6.9	Loamy sand
	5. *Desmostachya bipinnata* (L.) Stapf.	Xeroh.	NP	N	D	V	12.9	Clay loam
	6. *Dichanthium annulatum* (Forssk.) Stapf.	Xero.	NP	Mes	D	R	10.9	Silt loam
	7. *Imperata cylindrica* (L.) Raeuschel.	Psamm.	NP	N	D	R	10.7	Loamy sand
	8. *Phalaris minor* Retz.	Hyphal.	Th	Mic	F	R	11.2	Clay loam
	9. *Phragmites karka* (Retz.) Trin. ex. Steud.	Hyphal.	NP	Mic	D	V	13.6	Clay
	10. *Polypogon monspeliensis* (L.) Desf.	Psamm.	Th	Mic	D	R	9.6	Loamy sand
	11. *Saccharum spontaneum* L.	Hyphal.	MicP	N	R	R	9.8	Clay loam
	12. *Setaria pumila* L.	Psamm.	Th	Mic	F	R	10.3	Loamy sand
4.	**Typhaceae**							
	13. *Typha angustata* Bory & Chaub.	Hyphal.	NP	Mic	F	V	11.8	Clay loam
B.	**Dicotyledons**							
5.	**Asclepiadaceae**							
	14. *Calotropis procera* R. Br.	Xero.	NP	Mic	R	R	7.4	Fine sand
6.	**Asteraceae**							
	15. *Sonchus asper* (L.) Hill.	Xero.	Th	N	D	R	8.4	Fine sand
	16. *Xanthium strumarium* L.	Xero.	NP	Mac	F	V	9.6	Loamy sand
7.	**Brassicaceae**							
	17. *Coronopus didymus* (L.) Smith.	Xeroh.	Th	N	F	R	10.7	Silt loam
8.	**Chenopodiaceae**							
	18. *Chenopodium album* L.	Weedy	Th	N	F	R	10.2	Loamy sand
	19. *Chenopodium murale* L.	Weedy	Th	Mic	R	R	11.5	Silt loam
	20. *Kochia indica* Wight.	Xero.	Th	L	F	R	9.4	Fine sand
	21. *Suaeda fruticosa* (L.) Forssk.	Xeroh.	NP	L	F	R	15.8	Silty clay loam
9.	**Euphorbiaceae**							
	22. *Euphorbia granulata* Forssk.	Weedy.	Th	N	R	V	10. 2	Loamy sand
	23. *Euphorbia thymifolia* L.	Psamm.	Th	L	F	R	10.6	Loamy fine sand
10.	**Mimosaceae**							

	24. *Acacia nilotica* (L.) Delile.	Xero.	MesP	L	F	R	11.1	Loamy sand
11.	**Papilionaceae**							
	25. *Alhagi maurorum* Medik.	Hyphal	NP	N	F	V	12.2	Clay loam
	26. *Melilotus officinale* (L.) Desr.	Chasm.	Th	N	F	R	10.1	Loamy sand
	27. *Trifolium repens* L.	Psamm.	Ch	N	F	R	10.9	Loamy sand
12.	**Plantaginaceae**							
	28. *Plantago lanceolata* L.	Xero.	Ch	Mes	D	R	10.2	Loamy sand
	29. *Plantago major* L.	Psamm.	Ch	Mac	R	V	10.4	Loamy sand
13.	**Polygonaceae**							
	30. *Polygonum plebijum* R. Br.	Xero.	Ch	N	F	R	8.4	Fine sand
14.	**Primulaceae**							
	31. *Anagallis arvensis* L.	Xero.	Th	N	F	R	9.3	Fine sand
15.	**Rhamnaceae**							
	32. *Zizyphus nummularia* (Burm. f.) Wight & Arn.	Xero.	MicP	L	R	V	10.2	Loamy sand
16.	**Solanaceae**							
	33. *Solanum surattense* Burm. F.	Xero.	Ch	Mac	R	R	11.7	Loamy sand
	34. *Withania somnifera* (L.) Dunal.	Xero.	NP	Mic	F	R	11.1	Clay
17.	**Tamaricaceae**							
	35. *Tamarix aphylla* (L.) Karst.	Phrea.	MesP	N	F	V	12.6	Silty clay loam
18.	**Verbenaceae**							
	36. *Phyla nodiflora* (L.) Greene	Hyphal.	NP	N	F	R	9.2	Loamy sand
	37. *Verbena officinalis* L.	Hyphal.	NP	Mic	F	R	8.8	Fine sand

Keys:

Life-form classes: 1. Th= Therophytes; 2. Ch= Chamaephytes; 3. G= Geophytes; 4. NP= Nanophanerophytes; 5. MegP= Megaphanerophytes; 6. H= Hemicryptophytes; 7. MicP= Microphanerophyte; 8. MacP= Macrophanerophytes; 9. MesP=Mesophanerophytes

Leaf-size classes: 1. L= Leptophylls; 2. N= Nanophylls; 3. Mic= Microphylls; 4. Mes= Mesophylls; 5. Meg= Megaphylls; 6. Mac= Macrophyll

Abundance status: 1. R= Rare; 2. F= Frequent; 3. D= Dominant

Phenological classes: 1. V= Vegetative stage; 2. R= Reproductive stage

Plant Type (Halo-Physiotypic) Classification: 1. Xero = Xerohalophytes; 2. Hyphal= Hydrohalophytes; 3. Psamm= Psammophytes; 4. Weedy; 5. Xeroh = Xerohalophyte; 6. Chasm = Chasmophytes; 7. Phrea 8. Fibers

Table 2. Summary of plant type, life-form, leaf-size, abundance status and phenology of Halophytes of the University of Peshawar, Botanical Garden.

S. No.	Parameters	No. of species	Percentage %
A. Plant type classes			
1.	Xerohalophytes	12	32.43
2.	Hydrohalophytes	9	24.32
3.	Psammophytes	6	16.22
4.	Weedy	5	13.51
5.	Xerohalophyte	3	8.11
6.	Chasmophytes	1	2.70
7.	Phreatophytes	1	2.70
	Total	**37**	**100**
B. Life-form classes			
1.	Therophytes	13	35.14
2.	Nanophanerophytes	13	35.14
3.	Chamaephytes	5	13.51
4.	Mesophanerophytes	2	5.41
5.	Microphanerophytes	2	5.41
6.	Megaphanerophytes	1	2.70
7.	Hemicryptophytes	1	2.70
Total		**37**	**100**
C. Leaf size classes			
1.	Nanophylls	14	37.84
2.	Microphylls	11	29.73
3.	Leptohylls	6	16.21
4.	Macrophylls	3	8.12
5.	Mesophylls	2	5.41
6.	Megaphylls	1	2.70
Total		**37**	**100**
D. Abundance status			
1.	Frequent	21	56.76
2.	Rare	8	21.62
3.	Dominant	8	21.62
Total		**37**	**100**
E. Phenology			
1.	Reproductive	27	72.97
2.	Vegetative	10	27.03
Total		**37**	**100**

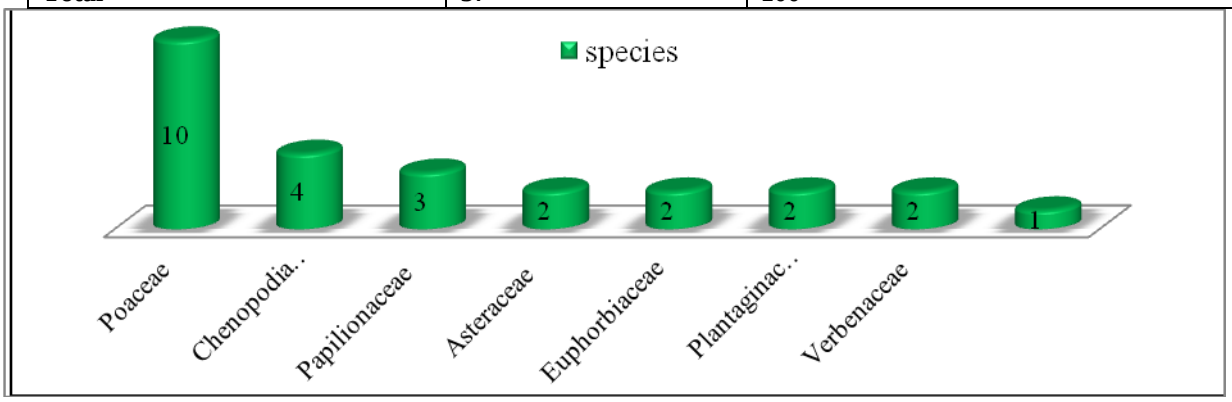

Fig. 1. Showing the number of species per family (2-10) and in remaining (1).

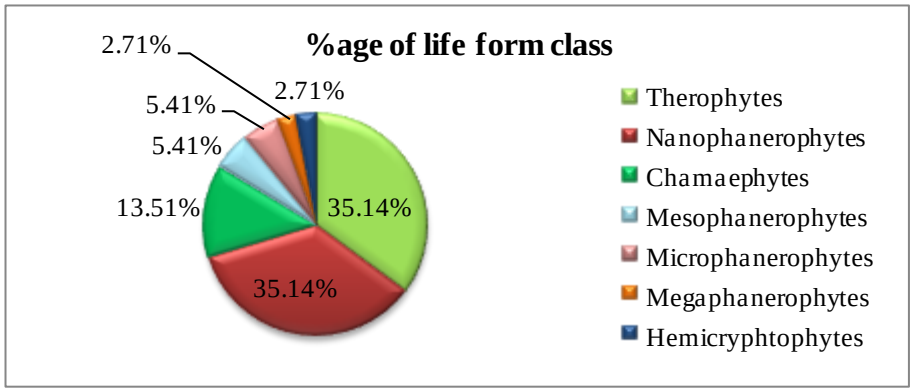

Fig. 2. Showing the percentage (%) of life form classes.

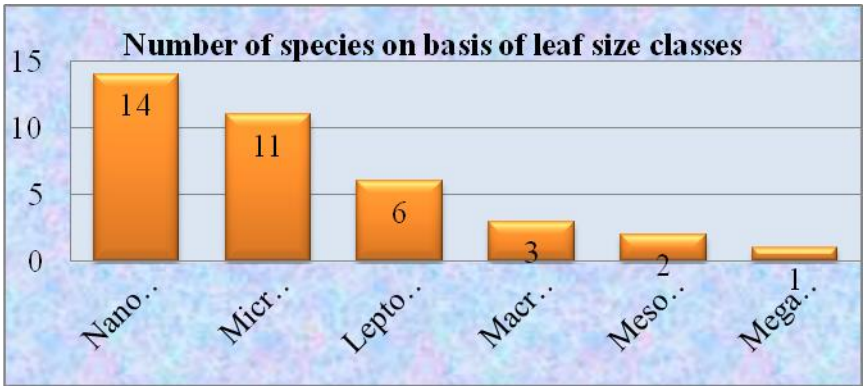

Fig. 3. Number of species on basis of leaf size classes.

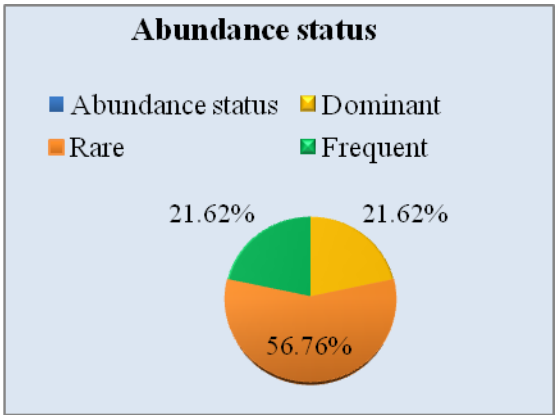

Fig. 4. % age of abundance status.

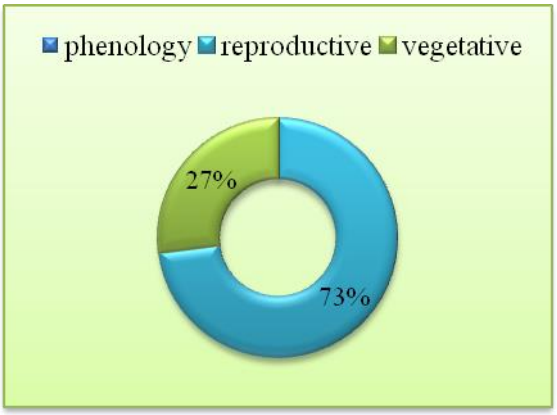

Fig. 5. %age of phenological classes.

forms and their ratio expressed in number or percentage (Khan, 2003). Shimwell (1971) recorded that therophytes depicts desert climate, geophytes shows Mediterranean climate, while hemicryptophytes indicates temperate zone. The climate of the studied area is of dry subtropical type. The life-form, leaf-size and phenology can be useful for the prediction of the climatic and edaphic factors and determination of Halophytic flora of the area.

On the basis of biological spectrum there were 13 (35.14%) species of Therophytes and Nanophanerophytes each, 5(13.51%) species of Chamaephytes, Microphanerophytes and Mesophanerophytes has 2 (5.41%) species each, Megaphanerophytes and Hemicryptophytes with 1 (2.70%) species each (Fig. 2). Life-size spectrum showed that 14(37.84%) species had nanophyllous, 11(29.73%) Microphyllous, 6(16.21%) Leptophyllous, while Macrophylls had3 (8.12%), Mesophylls 2(5.41%) and Megaphylls 1(2.70%) species (Fig. 3). Abundance status

indicated that 21(56.76%) were frequent followed by dominant and rare with 8(21.62%) species each (Fig. 4). All plant species undergo different phenotypic changes during its life cycle. Different types of Halophytic species were recorded during the present studies and the Halo-physiotypic classification was carried out, which shows that Xerohalophytes are the most dominant with 12 (32.43%) species, Hydrohalophytes 9 (24.32%), Psammophytes 6 (16.22%), Weedy 5 (13.51%), Xerohalophyte 3 (8.11%) species, while Chasmophytes and Phreatophytes with 1(2.70%) species each(Table 1 and 2).The investigation revealed that 27 (72.97%) species were in reproductive and 10 (27.03%) were in vegetative stage (Table 1 & 2 and Fig. 5). The halophytes are well adapted to the saline conditions. Shah and Hussain (2011); Hadi *et al*. (2009) and Hussain *et al.* (2009) reported *Desmostachya bipinnata, Imperata cylindrica, Phragmites karka, Saccharum spontaneum, Suaeda fruiticosa* and many others common halophytes from University of Peshawar Botanical Garden.

1. *Suaeda fruticosa* (L.) Forssk.

2. *Imperata cylindrica* (L.) Raeuschel.

3. *Tamarix aphylla* (L.) Karst.

4. *Calotropis procera* R. Br.

Plates 1-4. Some halophytes of grown in Peshawar University.

REFERENCES

Ahmed, N. and G.R. Chaudhary (1988). *Irrigated Agriculture of Pakistan*. Shahzad Nazir Publications, Lahore. 810.

Albert, R. (1975). Salt regulation in Halophytes. *Ocealogia*, 21: 57-71.

Ali, S. I. and M. Qaiser (1993-2014). *Flora of Pak*. Nos. 194-221. Deptt. of Botany, Karachi Uni. Karachi.

Ali, S. I. and Y. J. Nasir (1989-1991). *Flora of Pak*. Nos. 191-193. Deptt. of Botany, Karachi Uni. Karachi.

Aronson, J. (1989). Halophytes: Salt Tolerant Plants for the World - A Computerized Global DataBase of Halophytes with Emphasis on their Economic Uses. University of Arizona Press. Tucson, USA.

Aslam, R., N. Bostan, N. Amen, M. Maria and S. Safdar (2011). A critical review on halophytes: Salt tolerant plants. *Journal of Medicinal Plants Research*, 5 (33): 7108-7118.

Bakht, J., M. Shafi, A. A. Khan, S. Hussain, M. Tariq, H. Akbar, A. U. Jan and M. Rehman (2007). Growth performance of oat and barley at early seedling stage under saline environment. *Sarhad J. Agric.*, 23(3): 565-569.

Chaudhri, M.B., M.A. Main and M. Rafiq (1978). Nature and magnitude of salinity and drainage problems in relation to agricultural development in Pakistan. *Pak. J. Forest.*, 28: 70-72.

Glenn, E. P., M. C. Watson, J. W. Oleary and R. D. Axelson (1992). Comparison of salt tolerance and osmotic adjustment of low-sodium and high-sodium sub species of the C^4 Halophyte, *Atriplex canescens. Plant Cell Environ.*, 15: 711-718.

Glenn, E. P and J. J. Brown (1999). Salt tolerance and crop potential of halophytes. *Critical Reviews in Plant Sciences*, 18(2):227–255.

Hussain, F. (1989). *Field and Laboratory Manual of Plant Ecology*. UGC, Islamabad.

Hussain, A. and P. Gul (1991). Selection of Tree Species Suitable for Saline and Waterlogged Areas in Pakistan. *Pak. Jor. For*., 41 (1): 34-43.

Hussain, F., S. M. Shah, F. Hadi and A. Ullah (2009). Diversity and ecological characteristics of weeds of wheat fields of University of Peshawar Botanical Garden at Azakhel, District Nowshera, Pakistan. *Pak. J. Weed Sci. Res.*, 15(4): 283-294.

Hadi, F., M. Naseem, S. M. Shah, A. Ullah and F. Hussain (2009). Prevalence and ecological characteristic of summer weeds in crop and vegetable fields of Botanical Garden Azakhel, University of Peshawar, Pakistan. *Pak. J. Pl. Sci.*, 15 (2): 101-105.

Khan, M. A. (2003). *An ecological overview of Halophytes from Pakistan*. Khuwer Academic Publisher, Britain: 167-187.

Khan, M. A. and M. Qaiser (2006). Halophytes of Pakistan: Characteristics, Distribution and Potential Economic Usage In: M. A. Khan, H. Barth. G. C. Kust& B. Boer (Eds.) *Sabkha Ecosystems*: Volume II: The South and Central Asian Countries. Kluwer Academic Press, Netherlands. 129-154.

Marwat, S. K., K. Usman, R. A. Shah, A. Shah and E. A. Khan (2013). Floristic account of emergent-aquatic and marshland angiosperms of D.I. Khan District, KPK, Pakistan. *Pak. J. Bot*., 45 (SI): 279-288.

Munns, R., and M. Tester (2008) Mechanisms of salinity tolerance. *Annu. Rev. Plant Biol*., 59: 651–681.

McDonald R. C., R. F. Isbell, J. G. Speight, J. Walker and M. S. Hopkins (1998). Australian Soil and Land Survey Field Handbook: (Australian Collaborative Land Evaluation Program: Canberra).

Nasir, E. and S. I. Ali (1970-1989). *Flora of Pak.*, Nos. 1-190. Deptt. of Botany, Karachi Uni. Karachi.

Qureshi, M. A. and S. A. Khan (1965-67). Flora of Peshawar District and Khyber Agency. *Pak. J. For*., 15: 364-393 and 203-244.

Qureshi, M. A. and K. A. Khan (1971). An illustrated Flora of Peshawar District and Khyber Agency. Ranunculaceae to Moringaceae. *Pak. J. For.*, 1: 212.

Qureshi, R.H., M. Aslarn and M. Rafiq (1993). Expansion in the Use of Forage Halophytes in Pakistan. Proc. of Workshop, Perth, Western Australia, 42: 85-87.

Raunkiaer, C. (1934). *The life form at plants and Statistical Plants Geography*. Darendon Press Oxford. 23.

Shimwell, D. W. (1971).*The description and classification of vegetation*.Sedgewick and Jackson. London. 322.

Sarir, M. S., K. B. Marwat and J. K. Khattak (1984). Studies on some Halophytes of Peshawar District. *Pak. J. Bot.*, 16(1): 49-51.

Shah, S. M. and F. Hussain (2007). Ecology of waterlogged habitats around Chamkani, District Peshawar. *PUTAJ*., 14: 55-64.

Shah, S.M. and F. Hussain (2011). Floristic composition and ecological characteristics of weeds of sunflower crops of University of Peshawar Botanical Garden Azakhel, District Nowshera, Pakistan. *Pak. J. Pl. Sci.*, 17 (2): 117-120.

Smith, S. D., R. K. Monson and J. E. Anderson (1997).*Physiological Ecology of North American Desert Plants*. Springer Science & Business Media. 1-286.

Ungar, I. A. (1991). *Ecophysiology of Vascular Halophytes*. Boca Raton: CRC Press.9-48 & 209.

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