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The Floristic and Systematic Researches on the Poaceae in Van Center (Turkey)

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Abstract

This study was conducted on *Poaceae* samples growing in Van (Turkey) center between 2011 and 2015. After identification of plant samples 98 species, 11 subspecies, 6 varieties, totally 115 taxa belong to 46 genus were detected. A new species named *Aegilops vanensis* Öztürk & Şen (sp. nov.) which was recently discovered for the world botanical literature. *Phalaris canariensis*, *Schismus barbatus*, *Vulpia myuros*, *Alopecurus bulbosus* and *Bromus fasciculatus* are new records for B9 phytogeographic square. Some endemic species like *Agropyron deweyi* and *Trisetum thospiticum* were discovered. In addition, some rare taxa were found and their endangered categories were determined.

Keywords: flora, *Poaceae* (*Gramineae*), Systematic, Van, Turkey.

1. Introduction

Systematic and biodiversity studies are important to species conservation, extinction, biodiversity hotspots, bio-prospecting and ecosystem function (Smith, Wolfson, 2004). The analysis of the biodiversity as well as the analysis of the distribution of species richness at different levels, the distribution of the endemic species, the detection of areas whose preservation is necessary and many other topics related to the conservation of the biodiversity requires an important collection effort, so that the organized databases constructed by the herbaria become as comprehensive as possible (Crawford, Hoagland, 2009). The grass or Gramineae family (*Poaceae* Barnhart) consist more than 12.000 species and 763 genera in the World (Soreng et al., 2015b). The *Poaceae* family has economically and ecologically important taxa; because of this it represents a model family for the research. Gramineae is the fifth most species-rich family of flowering plants behind the Asteraceae (23. 000 spp.), Orchidaceae (28 000 spp.), Fabaceae (33 000 spp.) and Rubiaceae (13 500 spp.) (Hodkinson and Parnell, 2007). Gramineae taxa are also ecologically dominant, covering, as grasslands or bamboo forests, an estimated 40 % of the Earth's land surface (Gibson, 2008). Economically, *Poaceae* includes most important plants, providing our staple cereals such as *Eragrostis*, *Hordeum*, *Oryza*, *Secale*, *Sorghum*, *Triticum* and *Zea*; sugar crops such as *Saccharum* and *Sorghum*; reeds such as *Arundo* and *Phragmites*; and bamboo for food, building, and amenity materials such as *Bambusa* and *Phyllostachys* (Hodkinson et al., 2000). They also provide many forage and lawn grasses such as tropical species in *Cynodon*, *Digitaria*, *Panicum*, *Paspalum*, *Pennisetum*, *Stenotaphrum*, *Urochloa*, and *Zoysia* or temperate species in *Alopecurus*, *Cynosurus*, *Dactylis*, *Festuca*, *Lolium*, *Phleum* and *Poa* genera (Hodkinson et al.,

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2007). Recently, they have become important sources of raw material for the biomass and bioenergy industry such as *Arundo*, *Miscanthus*, and *Saccharum* and provide many species of horticultural and ethnobotany value (Jones et al., 2015). In addition, grasses are found on all continents and they are ecologically dominant in some ecosystems such as the African savannas (Kellogg, 2000). Most people on Earth depend on grasses, such as wheat, corn, oats, rice, sugarcane, and rye, for a large part of their diet, domestic animals are fed on diets based largely on forage grasses, many of the most serious weeds growing on agricultural lands (Peterson et al., 2010). In Turkey Poaceae hosts 146 genera including 547 species and 658 taxa (Doğan, Cabi, 2012). Eastern Anatolia Region, especially Van and Hakkari surroundings are important plant areas which have many endemic and Poaceae plants and significant floristic aspect.

In this research, Poaceae diversity of Van central region was investigated and the distribution of Poaceae members were tried to be determined more accurately and detailed. We can summarize some purposes of this study as follows: to gain Poaceae taxa which were not yet found in the VANF Herbarium; to do researches only Poaceae taxa around Van; to facilitate the diagnosis, difficulties and identification of some Poaceae members; to determine economically important Poaceae taxa (*Zea*, *Elymus*, *Festuca*, *Poa*, *Triticum*, *Agropyron*, *Aegilops*, *Phragmites*, *Lolium*, *Cynodon*, *Hordeum*, *Avena*, *Oryza*...); to determine allergitic Poaceae taxa (*Poa*, *Hordeum*, *Lolium*, *Bromus*, *Festuca*, *Stipa*, *Aegilops*..) which are important for human health. In the previous floristic studies which were conducted near our research area, only lists of Poaceae taxa were given; in this study, unlike the previous classical studies, many different Poaceae taxa were determined; features of some of them were emphasized, color photographs were introduced with names, endemism situations, endangered categories and geographical regions of studied samples were also indicated. In this study determination of different morphological features of some Poaceae samples has been tried to shed light on Poaceae literature. By using the Poaceae taxa which was pre-collected in the region or collected and analyzed by us afterwards, it was possible to determine more realistic features of the variation boundaries of the various species and the characters used in the definition and diagnosis; thus provide some facilities identification Poaceae taxa. In addition, some morphological features and population of Poaceae members which were used in agriculture, landscape, pharmacy, food, ethnobotany. have been determined.

Although the plants of Van region are generally studied in terms of floristic, phytosociological and systematic aspects; but has not been found such systematic study involving only Poaceae (Gramineae). For these reasons, this study was carried out on the only Poaceae taxa of the Van (Turkey) center.

2. Materials and methods

The research material consists of Poaceae taxa from center of Van (Turkey). 98 species, 11 subspecies and 6 varieties, totally 115 taxa were detected. During the vegetation period of 2011-2015, plant samples were collected from research area at different periods. Also pre-collected ready materials were also evaluated. Collected samples were pressed and dried according to herbarium technique. "Flora of Turkey and the East Aegean Islands" books, herbarium samples and topical books were used to identification of plant samples (Davis, 1985; Güner et al., 2000; Zeynalov et al., 2011; Tatlı, 1988; Korkmaz, 2010; Polunin and Huxley, 1970). Besides, where necessary Flora Europea (Tutin et al., 1964-1981), Flora of Iraq (Townsend, Guest, 1966-1985), Flora of Iranica (Rechinger, 1965-1977), Flora Palaestina (Zohary, 1966-1986), Flora of USSR (Komarov et al., 1934-1964) were used to identification plant taxa. Important characters (gluma, lemma, palea, sheath, lamina, ligula, spica, spicula, rachilla, nod, internod, awn, leaf shapes, flower, root and stem structures) of the Poaceae family were used to identification of taxa. The genus and species names of the plants were arranged according to the alphabetical system and was given in the findings part. Different features of plant samples from Turkey's Flora, distribution areas, endemism, endangered categories and most photos of plant samples were showed in Figure 1. Identified specimens were adhered to herbarium cartons in a regular and careful manner and recorded to the herbarium (VANF) notebook. Then these samples were placed in cupboards of Herbarium and recorded on the website of the VANF Herbarium.

3. Results and discussion

With this study, 98 species, 11 subspecies and 6 varieties (totally 115 taxa) were detected and 64 taxa were added to the number of Poaceae taxa, which were not identified in previous studies for Van central region. *Aegilops triuncialis* and *Taeniaterum caput-medusa* are common plant associations in the meadows; *Bromus tomentellus*, *Poa bulbosa* and *Hordeum murinum* are mostly found under trees; *Phragmites australis* was widespread plant associations in wetlands. In research area determination of *Phalaris canariensis*, *Schismus barbatus*, *Trisetum thospiticum* is noteworthy. A new species named *Aegilops vanensis* Öztürk, Şen which was recently discovered for the botanical literature. *Vulpia myuros*, *Alopecurus bulbosus* and *Bromus fasciculatus* are detected as new records for B9 phytogeographic square (Yıldırım, 2017). Some endemic species like *Agropyron deweyi* and *Trisetum thospiticum* were found. In addition, some rare taxa were found and their endangered categories were determined. The fact that *Paspalum dilatatum* was collected once and is not found again during study; this is one of the indicators that this species was decreased. VANF herbarium gained *Stipa hohenackeriana* ve *Stipa ehrenbergiana* species with this study. Alphabetical list of detected taxa as below:

AEGILOPS L.: *A. cylindrica* L., *A. triuncialis* L., *A. vanensis* Öztürk & Şen (sp. nova), *A. tauschii* Coss., *A. markgrafii* (Greuter) Hammer, *A. columnaris* Zhukovsky.

AGROPYRON Gaertn.: *A. cristatum* (L.) Gaertner subsp. *pectinatum* (Bleb.) Tzvelev. var. *pectinatum* (L.) Gaertner, *A. deweyi* A.Löve. End.

AGROSTIS L. : *A. gigantea* Roth., *A. stolonifera* L.

ALOPECURUS L. : *A. arundinaceus* Poiret, *A. myosuroides* Huds. var. *myosuroides*, *A. bulbosus* Gouan

ARUNDO L.: *A. donax* L.

ARRHENATHERUM P. Beauv.: *A. palaestinum* Boiss.

AVENA L.: *A. sterilis* L. subsp. *ludoviciana*

BOTHRIOCHLOA O.Kuntze: *B. ischaemum* (L.) Scop.

BROMUS L.: *B. danthoniae* Trin., *B. fasciculatus* C. Presl., *B. hordeaceus* L., *B. inermis* Leysser., *B. intermedius* Guss., *B. japonicus* Thunb. subsp. *japonicus*, *B. scoparius* L., *B. sterilis* L., *B. tectorum* L. subsp. *tectorum*, *B. tomentellus* Boiss., *B. erectus* Huds., *B. riparius* Rehm., *B. armenus* Boiss.

CALAMAGROSTIS Adans : *C. pseudophragmites* (Huller fill) Koeler., *C. epigejos* (L.) Roth., *C. arundineae* (L.) Roth.

CATABROSELLA L. : *C. parviflora* (Boiss & Buhse) Alexeev ex R. Mill.

CYNODON L. : *C. dactylon* (L.) Pers. var. *villosus* Regel

DACTYLIS L. : *D. glomerata* L. subsp. subsp. *hispanica* (Roth) Nym.

DESCHAMPSIA P. Beauv: *D. caespitosa* (L.) P. Beauv.

DIGITARIA Heis. Ex Fabr. : *D. sanguinalis* (L.) Scop.

ERAGROSTIS P. Beauv.: *E. pilosa* (L.) P. Beauv., *E. minor* Host.

ELYMUS L.: *E. hispidus* (Opiz.) Meld. subsp. *hispidus*, *E. repens* (L.) Gould. subsp. *repens*

EREMOPYRUM (Ledeb.) Jaub & Spach.: *E. confusum* Meld., *E. orientale* (L.) Jaub. Et Spach, *E. boneapartis* (Spreng) Nevski., *E. distans* (C.Koch) Nevski.

ELEUSINE Gaertner: *E. indica* (L.) Gaertner

EREMOPOA Rozhev.: *E. multiradiata* (Trautv) Roshev., *E. persica* (Trin.) Roshev., *E. songarica* (Shrenk) Roshev.

ECHINOCLOA L.: *E. cruss-galli* (L.) P. Beauv., *E. oryzoides* (Ard) Fritsch.

FESTUCA L.: *F. arundinaceae* Schreb. subsp. *arundinaceae*., *F. ovina* L., *F. pratensis* Huds.

HENRARARDIA C.H.Hubbard.: *H. persica* (Boiss.) C.H.Hubbard. var. *persica*

HETERANTHELIUM Hochst.: *H. piliferum* (SOL) Hochst,

HORDEUM L.: *H. geniculatum* (Soll) Hochst., *H. murinum* Huds. subsp. *murinum*, *H. marinum* Huds., *H. distichon* L., *H. violeceum* Boiss & Huet., *H. bulbosum* L., *H. spontaneum* var. *anatolicum* K. Koch.

KOELERIA Pers.: *K. cristata* (L.) Pers., *K. eriosachya* Panic.

LOLIUM L.: *L. perenne* L., *L. persicum* Boiss.& Hohen ex Boiss., *L. rigidum* L.

ORYZA L.: *O. sativa* L.

PANICUM L.: *P. miliaceum* L.

- PASPALUM** L.: *P. dilatatum* Poiretti.
PHALARIS L.: *P. canariensis* L.
PHLEUM L.: *P. montanum* C.Cohh var. *montanum*, *P. pratense* L.
PHRAGMITES L.: *P. australis* L.
POA L. : *P. bulbosa* L., *P. pratensis* L., *P. trivalis* L., *P. angustifolia* L.
PUCCINELLIA Parl.: *P. gigantea* (Grossh) Grossh.
SECALE L.: *S. cereale* L. var. *vavilovii*, *S. montanum* Guss.
SETARIA (L.) P. Beauv.: *S. verticillata* (L.) P. Beauv var. *verticillata*, *S. viridis* (L.) P.Beauv., *S. glauca* (L.) P. Beauv.
SCHISMUS L.: *S. barbatus* (L.) Thell.
SCLEROCLOA P.Beauv.: *S. dura* (L.) P. Beauv.
SORGHUM Moench: *S. halepense* (L.) Pers.
STIPA L.: *S. hohenackeriana* Trin & Rupr. var. *assyriaca*, *S. holosericea* Trin & Rupr., *S. ehrenbergiana* Trin & Rupr.
TAENIATHERUM Nevski.: *T.caput-medusa* (L.)Nevski subsp. *crinitum* (Schr.) Meld.
TRisetum Chrtek. : *T. thospiticum* Chrtek.
TRITICUM L.: *T. aestivum* L., *T. vulgare* L.
VULPIA C.C Gmelin: *V. myuros* (L.) C.C.Gmelin.
ZEA L.: *Z. mays* L.

Vulpia myuros, *Alopecurus bulbosus* and *Bromus fasciculatus* are detected as new records for B9 phytogeographic square (Yıldırım, 2017); so with this research original results were obtained for our region, Turkey and botanical literature. For example, so far unknown three species (*Phalaris canariensis*, *Schismus barbatus*, *Trisetum thospiticum*) were detected and their endangered categories (EN) was determined. Besides, *Aegilops vanensis* Öztürk & Şen was detected as new species with this research. In Flora of Turkey *P. canariensis* was spreading till 1000 meters in the A1, A2, B1, B4, C5 phytogeographic squares and shown as a Mediterranean element; it is an originality that this species, which has not been encountered before in the area and its surroundings, was discovered in Van in the Iran-Turan phytogeographic region where the continental climate is dominant. *Koeleria eriostachya* ve *Agropyron deweyi* (endemic species) has been determined from Van provinces. It is noteworthy that our collected *Aegilops* species area similar to *Aegilops triuncialis*; but grows in a different ecological niche on soft-loose soil piles, physiologically the stems are curled by a corner, cluster formed, the spiculas were less frequent (5-6), scattered irregularly on the spicas (5-6 cm), the glum veins were more prominent, the arista and the stems were harder and longer. For these reasons, our *Aegilops* species has 6-7 different characters from *Aeglops triuncialis*; so our *Aegilops* species was evaluated as a new species called *A. vanensis* Öztürk & Şen. In the flora of Turkey although only the lower face of gluma of *Phleum pratense* was hairy; in our sample we detected that both face of gluma was hairy. In the flora of Turkey although the lower face of lamina of *Henrardia persica* was not hairy; in our sample we detected that the lower face of lamina was hairy. In the flora of Turkey although the upper gluma of *Eragrostis minor* has single veined; in our sample we detected three veins and this is an important variation. *Dasypyrum villosus* were collected before from YYU campus; we corrected and identified this species as *Secale montanum* with detailed studies. Because of most of Poaceae genera are cosmopolitan, the same species of Poaceae are found in more than one area in our study area. It is interesting that we have not encountered some species (*Triticum dicoccon*, *Festuca brunescens*, *Stipa lessingiana*) that have potential to be encountered in the area despite the addition of 64 species to the Poaceae members in and around the area. *Koeleria eriostachya* and *Eragrostis pilosa* rare in eastern part of Turkey we detected this species in our field work. In Flora of Turkey inflorescence of *Koeleria eriostachya* was 2-8 cm, in our sample was 8-17 cm also there are pillose hairs on the panicle nodyum. In Flora of Turkey *Alopecurus bulbosus* spreading in Western Europe and Mediterranean phytogeographic region and anter length stated as 1.3-1.8 mm; our sample is in the Iran-Turan phytogeographic region and anter length is 1.9 mm, awn length of lemma is 2 mm, new record for B9 square, stem has was 2-3 nodyums, palea was blunt; it is very interesting to collect this species in our region and it is known that it is spreading generally around Istanbul. In Flora of Turkey *Vulpia myuros* was not given in Eastern Anatolia, was given only Rize, inner Thrace and Gaziantep; so this species can be evaluated “threaten” (NT) endangered

categories. According to the literature, *Agropyron cristatum* subsp. *pectinatum* var. *imbricatum* is usually spreading at high altitudes (1700–2900 m); in our study, it was collected at 1600–1650 meters in the center of Van. The added species from Yuzuncu Yil University Zeve Campus (Ozturk et al., 1998) as follows: *Apera intermedia*, *Catabrosa aquatica*, *Calamagrostis pseudophragmites*, *Eremopyrum confusum*, *Eremopyrum orientale*, *Eremopoa persica*, *Elymus repens* subsp. *repens*, *Cynodon dactylon* var. *villosus*, *Festuca oreophila*, *Hordeum bulbosum*, *Hordeum violaceum*, *Psathyrostachys fragilis*, *Eragrostis minor*, *Eragrostis barrelieri*.

4. Conclusion

In conclusion, although the number of Poaceae species identified in each of floristic studies previously conducted in the province of Van is at least 8 species, most 30-35 species; with this study, 98 species, 11 subspecies and 6 varieties (totally 115 taxa) were detected and 64 taxa were added to the number of Poaceae taxa of Van center and contributions provided to Poaceae literature.

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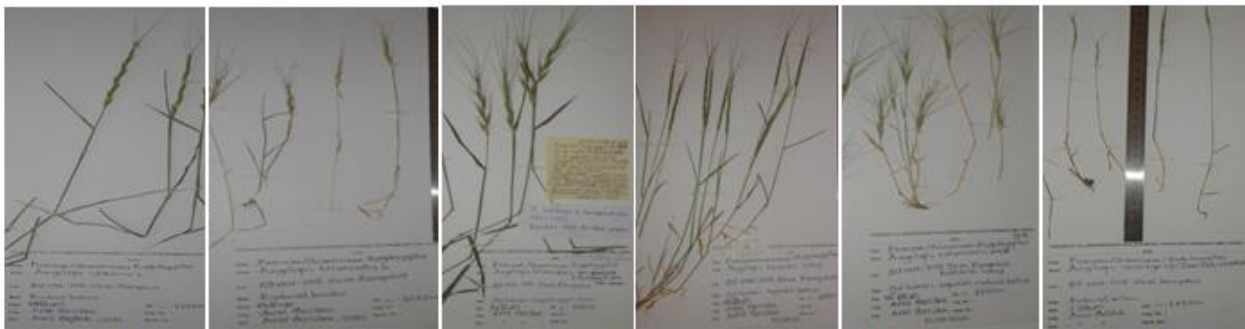
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Appendix

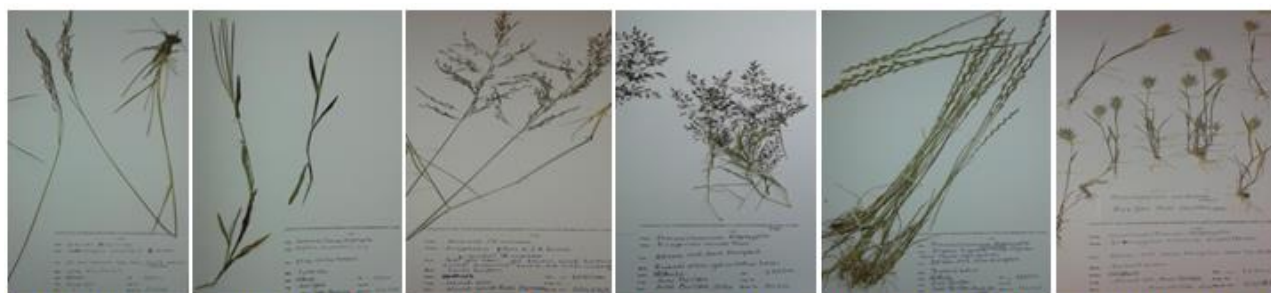




Bromus inermis *Bromus intermedius* *Bromus japonicus* subsp. *japonicus* *Bromus scoparius* *Bromus sterilis* *Bromus tectorum* subsp. *tectorum*



Bromus tomentellus *Bromus armenus* *Calamagrostis pseudophragmites* *Calamagrostis epigejos* *Calamagrostis arundinacea* *Catabrosella parviflora*



Deschampsia caespitosa *Digitaria sanguinalis* *Eragrostis pilosa* *Eragrostis minor* *Elymus hispidus* subsp. *hispidus* *Eremopyrum confusum*



Eremopyrum orientale *Eremopyrum distans* *Eleusine indica* *Eremopoa multiradiata* *Eremopoa songarica* *Echinochloa crus-galli*



Echinochloa oryzoides *Festuca arundinacea* *Festuca pratensis* *Henrardia persica* var. *persica* *Heteranthelium piliferum* *Hordeum geniculatum*

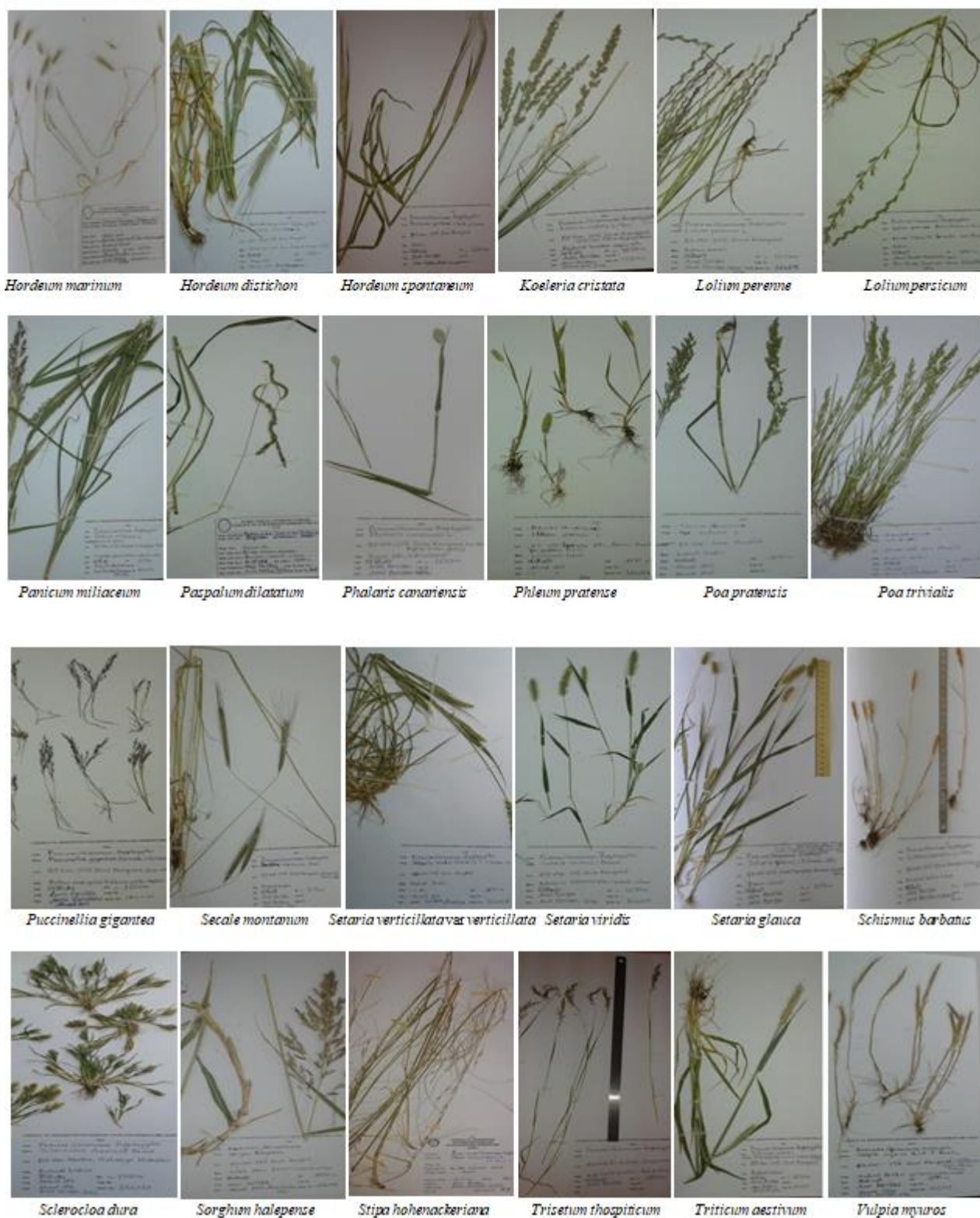


Fig. 1. Some plant taxa in the research area