

Original article

Alien plant species (ephemerophytes) in Romensko-Poltavsky Geobotanical District, Ukraine

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ABSTRACT

This paper presents the results of research on ephemerophytes of the alien portion of the flora of the Romensko-Poltavsky Geobotanical District (north-eastern Ukraine). It is a detailed study of this group of plants, conducted for the first time in the Ukraine. The checklist of alien vascular plants contains 345 species, of which 27 species are ephemerophytes (or 8%): *Adonis aestivalis*, *A. annua*, *Papaver albiflorum*, *Urtica cannabina*, *Gypsophila perfoliata*, *Atriplex micrantha*, *Chenopodium × preissmannii*, *Ch. × thellungii*, *Rumex longifolius*, *Sisymbrium polymorphum*, *Euphorbia humifusa*, *Malus sylvestris*, *Onobrychis viciifolia*, *Astrodaucus orientalis*, *Datura tatula*, *Solanum schultesii*, *Lindernia procumbens*, *Melampyrum cristatum*, *Helianthus annuus*, *Petasites spurius*, *Xanthium ripicola × Xanthium albinum*, *Echinochloa tzvelevii*, *Panicum capillare*, *Panicum capillare* L. subsp. *barvipulvinatum*, *Phalaris canariensis*, *Setaria × ambigua*, *Sorghum halepense*. The basis of this work is original data of the author obtained during field studies, and a critical study of the literature, archival, cartographic materials and herbarium collections, and the use of classical methods of botanical classification. Complex research of this group of plants was conducted and as a result of these investigations the following characteristics were established: a predominance of kenophytes of Mediterranean origin in this group, species of arid areas, cosmopolitan species with a diffuse type of space structure, therophytes, herbaceous monocarpic plants, mesotrophes, heliophytes and xeromesophytes, with an insignificant degree of impact on native plant communities and with a limited distribution within the study region. The combination of these results indicates that ephemerophytes comprise a temporary, unstable component of the flora of this region of the Ukraine. The paper provides maps of the distribution of these 27 species.

KEY WORDS: alien flora, ephemerophytes, Romensko-Poltavsky Geobotanical District, Ukraine

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1. Introduction

At present, one of the main tasks of modern floristics is researching the alien of the flora – establishing its current species composition, establishing ways of entry of alien plant species, features of naturalization and monitoring. The problem of alien species has been discussed at different international conferences and forums, dedicated to the conservation of biodiversity and plant invasions.

A number of foreign and national publications have been devoted to the research on alien flora and invasive plant species and interest in this subject increases each year (ELTON, 1958; KORNAŚ, 1968; 1977; WILLIAMSON, 1996; WEBER, 1997; PROTOPOPOVA ET AL, 2002; KOWARIK, 2003; DAVIS,

2003; MORSE ET AL., 2004; PYŠEK ET AL., 2004; RICHARDSON & PYŠEK, 2006; ANASTASIU & NEGREAN, 2007; VINOGRADOVA ET AL., 2010; KUCHER, 2016).

Studying the processes of adventization of vegetation cover in some regions of the Ukraine is a large task due to increased anthropopression. The alien portion of the flora is the most dynamic and heterogeneous component. One of the basic processes of anthropogenic transformation of the flora is the naturalization of alien species. This naturalization is understood to be the complete process of rooting alien species within the native flora or the ability of plants to yield progeny in new conditions and within new plant communities (PROTOPOPOVA & SHEVERA, 2005, 2012). Alien flora consist of stable (epycophytes, agrioepecophytes, agriophytes and colonophytes) and temporary

(ergasiophytes and ephemerophytes) components (RICHARDSON ET AL., 2000; PROTOPOVA, 2003; PYŠEK ET AL., 2004). One of the interesting groups of plants are those which have a low level of naturalization (ephemerophytes and ergasiophytes) indicating their instability within the native flora. In Europe and in the Ukraine these groups of plants are poorly understood, especially ephemerophytes.

The main interest of our research are ephemerophytes, conducting a complex analysis, studying their distribution character in the region, with the purpose of establishing their role in the formation of a modern flora. According to the terminology used by RICHARDSON ET AL. (2000) ephemerophytes are alien species that overcame only the geographical barrier ("A" and "B") and occur locally and are unstable. We use this definition in our work.

2. Materials and methods

2.1. Study area

According to the geobotanical zoning of the Ukraine the study area belongs to the Romensko-Poltavsky Geobotanical District (*hereinafter* R-PGD) (BARBARUCH, 1977), by botanical-geographic

zoning (HELUTA, 1989) – to the Left Bank Forest Steppe; by physical-geographic zoning – to the Forest Steppe zone (POPOV, 1968). In administrative terms the territory of the region covers most of the Poltava region (except southern regions), is in the southeastern part of the Chernihiv region, the southern part of the Sumy and western part of the Kharkiv regions (Fig. 1). The total area of R-PGD is about 30 000 km².

Most of the territory is located in Prydniprovsky lowland and partly on spurs of the Central Russian Upland. The surface is plain undulating and sloping to the Dnipro, dissected by the rivers valleys of Sula, Psel, Vorskla, Orel and their tributaries. Territory of the district rises in the direction from south west to north east (MATZA, 1998).

The researched region belongs to two geostructural districts: to Ukrainian crystalline shield and Dnipro-Donets basin. Both tectonic structures are part of the Eastern European (Russian) platform (BULAVA, 1996). The climate is temperate continental (BABUCHENKO ET AL., 1984). According to agro-soil zoning of Ukraine R-PGD belongs to Forest-Steppe zone, the province is Eastern Steppe Upland, which is characterized by typical black soil and podsolich soil types (VERNANDER ET AL., 1986; MATZA, 1998).



Fig. 1. The location of the Romensko-Poltavsky Geobotanical District (R-PGD) in Ukraine

2.2. Data and methods

The present research focuses on the study of ephemerophytes of the flora of the Romensko-Poltavsky Geobotanical District (R-PGD). This paper presents the results of a study and generalization of the literature, a critical study of herbarium collections of M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine (KW), acad. O.V. Fomin Botanical Garden, Taras Shevchenko National University of Kyiv (KWHU), V.N. Karazin Kharkiv National University (CWU), Poltava National V.G. Korolenko Pedagogical University (PWU), the Poltava Museum of Local Lore named after Vasyl Krichivsky (PW), Poltava State Agrarian Academy and Research Station of medicinal plants, Institute of Agroecology and Environmental Sciences, National Academy of Agricultural Sciences of Ukraine and our own field research during the period 2010–2016.

Using the route-expeditionary method with subsequent camera processing of field data research was conducted (more than 30 expeditionary trips were performed, herbarium specimens collected and saved in the KW, KWHU, CWU, PWU, PW and others).

For the region in the system of UTM coordinates a grid map was produced with a cell size of 5 x 5 km, which is consistent with the grid adopted in "Atlas Florae Europaeae". In developing the map the MapInfo system was used, with the scale 1:200 000 taken as a basis. The territory of R-PGD covers 18 grid squares UTM 50x50 km. Within the square 50x50 km there are 100 square 5x5 km (BUDZHAK & DVIRNA, 2014).

The systematic and florogenetic analyses presented in the paper are based on TOLMACHEV principles (1941, 1962, 1974, 1986). A checklist of ephemerophytes has been completed, the names of species and their authors are indicated by „Vascular plants of Ukraine. A nomenclature Checklist" (MOSYAKIN & FEDORONCHUK, 1999).

Geographical analysis is performed by the hierarchical system of geoelements KLEPOV (1938, 1990). The analysis of biomorphological structure is based on a system of life forms by RAUNKIAER (1905) and life forms by SEREBRYAKOV (1962); ecological analysis – by ecological scales of DIDUKH (2011); type of spatial structure of distribution – by PROTOPOVAS' classification (1991).

As for the classification of the degree of naturalization of the plants we adhere to classification scheme of all alien species on the degree of naturalization regardless of the time of their first introduction according SCHROEDER (1969), which have been modified by PROTOPOVA & SHEVERA (2005, 2012). Analysis of species by

the time of introduction is performed according to the classification of KORNAŠ (1968, 1977). The assessment of invasiveness of each species has been defined by using „An Invasive Species Assessment Protocol" (MORSE ET AL., 2004).

3. Results and discussion

The checklist of the alien portion of the flora of the Romensko-Poltavsky Geobotanical District is represented by 345 species of vascular plants belonging to 208 genera and 62 families (DVIRNA, 2014, 2015). The total share of epecophytes (61%), agriophytes (5%), agrioepecophytes (2%) and colonophytes (1%) is most of the species composition of the alien portion of the flora of the region – 237 species (69%), being its stable component. Unstable component – 105 species (31%) – is represented by ephemerophytes (8%) and ergasiophytes (21%).

We have established that ephemerophytes are represented by 27 species (8%), belonging to 24 genera, 15 families, 13 orders, 2 classes. We have noted 27 species of ephemerophytes: *Adonis aestivalis* L., *Adonis annua* L., *Papaver albiflorum* Pacz. (Boiss.), *Urtica cannabina* L., *Gypsophila perfoliata* L., *Atriplex micrantha* C.A.Mey, *Chenopodium × preissmannii* J.Murr, *Chenopodium × thellungii* J.Murr., *Rumex longifolius* DC., *Sisymbrium polymorphum* (Murray) Roth., *Euphorbia humifusa* Willd. ex Schlecht., *Malus sylvestris* Mill., *Onobrychis viciifolia* Scop., *Astrodaucus orientalis* (L.) Drude, *Datura tatula* L., *Solanum schultesii* Opiz, *Lindernia procumbens* (Krock.) Borbás., *Melampyrum cristatum* L., *Helianthus annuus* L., *Petasites spurius* (Retz.) Rchb., *Xanthium ripicola* Holub. × *Xanthium albinum* (Widder.) H.Scholz, *Echinochloa tzvelevii* Mosyakin ex Mavrodiev & H.Scholz, *Panicum capillare* L., *Panicum capillare* L. subsp. *barvipulvinatum* (Nash) Tzvelev, *Phalaris canariensis* L., *Setaria × ambigua* Guss., *Sorghum halepense* (L.) Pers.

The richest families belong to the *Poaceae* (6 species, or 22 %), *Asteraceae* (3, or 11 %) and *Chenopodiaceae* (3, or 11 %), other families are represented by 2 (*Ranunculaceae*, *Solanaceae*, *Scrophulariaceae*) and 1 species (*Papaveraceae*, *Urticaceae*, *Caryophyllaceae*, *Polygonaceae*, *Brassicaceae*, *Euphorbiaceae*, *Rosaceae*, *Fabaceae*, *Apiaceae*). Taxonomic analysis reflects the internal specifics of systematic diversity. It was established that the genera *Adonis* L., *Chenopodium* L. and *Panicum* L. comprise 2 species, other 21 genera – 1.

The analyses of origin of ephemerophytes allocated the following predominant groups: Medi-terranean (5 species), North American and hybridogenic (4 species), unexplained (2 species),

other groups comprise one species. The analysis concerning affinity of primary ranges to bioclimatic areas showed that among the studied group of plants the most typical are species of arid areas which are 14 (52%).

As a result of the analysis of the current geographical area of distribution of ephemerophytes of the researched flora 13 types of distribution were identified. Cosmopolitan types of distribution are predominant – 5 species (19% of the total number), Holarctic and Euro-Mediterranean-Iran-Turan by 3 species (11%), other types of distribution by 1-2 species. To determine the degree of participation of some floristic regions in the formation of unstable component of the alien fraction of the flora of the R-PGD we have identified three main areographic groups: ancient Mediterranean distribution groups with 10 species (37%), Holarctic – 9 species (33%) and polyregional – 8 species (30%).

One of the important indicators of phytogeographic analysis is the character of spatial structure of distribution of ephemerophytes. In the studied territory, we identified 5 types of space areas structure; the dominant ones being diffuse – 17 species (63% from total number of ephemerophytes), band-diffuse and local – by 4 species (by 15%), tape and focal – by 1 species (by 4 %).

In the spectrum of biomorphs a herbaceous monocarpic plants dominate – 17 species (63% from the total number of ephemerophytes), terophytes – 22 species (81%). In the spectrum of ecomorphes the dominant ones are xeromesophytes – 12 species (44%), heliophytes – 23 species (85%) and mesotrophes – 18 species (67%). On account of the arrival time, we found that kenophytes dominate – 26 species (96%).

According to “An Invasive Species Assessment Protocol” (2004) we attempted to assess the impact of analyzed ephemerophytes on native /indigenous flora under the conditions of the studied region. It was established that these species are characterized by a low index I-Rank = 0–25. There follows a brief description of ephemerophytes according to a scheme that includes the following characteristics: chronological element, origin, current area of distribution, type of spatial structure of distribution ecomorphes, life form, I-Rank, habitat and the distribution map.

Adonis aestivalis L. – archaeophyte of Mediterranean-Iran-Turan origin, Euro-Mediterranean-Iran-Turan, band-diffuse, mesotroph, heliophyte, submesophyte, cryptophyte, herbaceous polycarpous plants, I-Rank = 0, on the steppe slopes (Fig. 2A).

Adonis annua L. – kenophyte of Mediterranean origin, Euro-Mediterranean area, diffuse, meso-

trophe, heliophyte, submesophyte, therophyte, herbaceous monocarpic plant, I-Rank = 0, on the dry slopes (Fig. 2B).

Papaver albiflorum (Boiss.) Pacz. – kenophyte of unexplained origin, Euro-Mediterranean area, diffuse, mesotrophe, heliophyte, submesophyte, therophyte, herbaceous monocarpic plant, I-Rank = 0, along roads (Fig. 2C).

Urtica cannabina L. – kenophyte of Middle Asian origin, Euro-Mediterranean-Iran-Turan area, diffuse, eutrophic, scyoheliophytes, mesophyte, hemicryptophytes, herbaceous polycarpous plants, I-Rank = 0, along roads, in disturbed places (Fig. 2D).

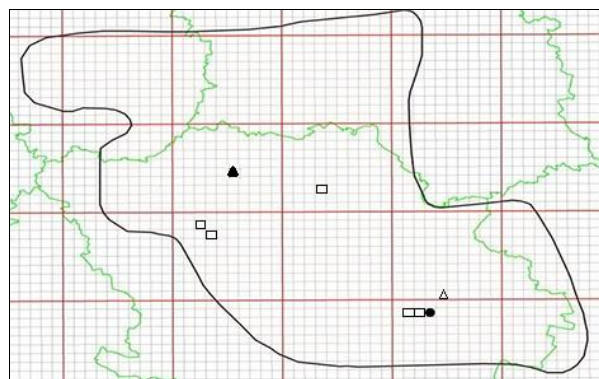


Fig. 2. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Adonis aestivalis* L.; B. ▲ - *Adonis annua* L.; C. ▲ - *Papaver albiflorum* (Boiss.) Pacz.; D. □ - *Urtica cannabina* L.

Gypsophila perfoliata L. – kenophyte of Eastern European origin, Euro-Asian area, diffuse, mesotrophe, heliophyte, xeromesophytes, hemicryptophyte, herbaceous polycarpous plant, I-Rank = 0, along railways (Fig. 3A).

Atriplex micrantha C.A. Mey. – kenophyte of Central Asian origin, Euro-Asian area, diffuse, mesotrophe, heliophyte, mesophyte, therophyte, herbaceous monocarpic plant, I-Rank = 0, in disturbed wet places and on the banks of rivers, lakes (Fig. 3B).

Chenopodium × preissmannii J.Murr – kenophyte of hybridogenic origin, Holarctic area, diffuse, mesotrophe, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank = 0, at the cemetery (Fig. 3C).

Chenopodium × thellungii J.Murr – kenophyte of hybridogenic origin, Holarctic area, diffuse, mesotrophe, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank = 0, on the rubbish dump (Fig. 3D).

Sisymbrium polymorphum (Murray) Roth – kenophyte of Iran-Turan origin, Euro-Mediterranean-Asian area, diffuse, oligotrophe, heliophyte, subxerophyte, hemicryptophytes, herbaceous polycarpous plant, I-Rank=0, in steppe areas (Fig. 4A).

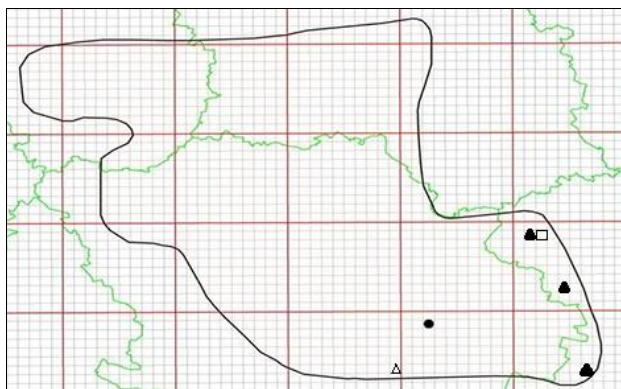


Fig. 3. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Gypsophila perfoliata* L.; B. ▲ - *Atriplex micrantha* C.A. Mey; C. △ - *Chenopodium x preissmannii* J. Murr; D. □ - *Chenopodium x thellungii* J. Murr

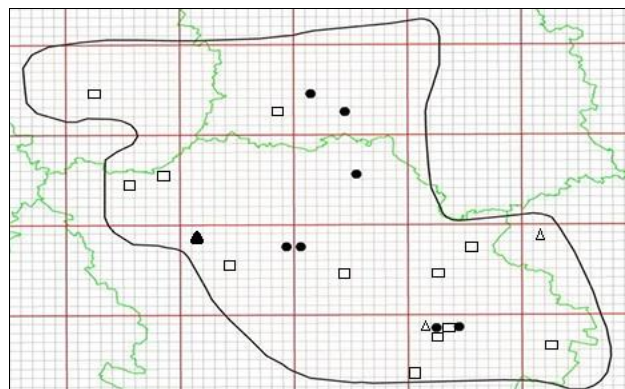


Fig. 4. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Sisymbrium polymorphum* (Murray) Roth; B. ▲ - *Rumex longifolius* DC.; C. △ - *Malus sylvestris* Mill.; D. □ - *Onobrychis viciifolia* Scop.

Rumex longifolius DC. – kenophyte of unexplained origin, European-American area, band-diffuse, mesotrophe, heliophyte, mesophyte, hemicryptophyte, herbaceous polycarpous plant, I-Rank=0, in meadow areas (Fig. 4B).

Malus sylvestris Mill. – kenophyte of Central European origin, European area, diffuse, mesotrophe, heliosciophyte, mesophyte, phanerophyte, polycarpous plant, I-Rank=0, in forests, along roadsides, on the banks of rivers (Fig. 4C).

Onobrychis viciifolia Scop. – kenophyte of South European origin, Euro-Mediterranean-Iran-Turan area, band-diffuse, mesotrophe, heliophyte, xeromesophyte, hemicryptophyte, herbaceous polycarpous plant, I-Rank=8, on the dry slopes, stepped on the meadows, along roads (Fig. 4D).

Astrodaucus orientalis (L.) Drude – kenophyte of pontic origin, Euro Asian origin, diffuse, mesotrophe, heliophyte, mesophyte, therophyte, biennial herbaceous monocarpic plant, I-Rank=0, in pastures, hayfields and vegetable patches (Fig. 5A).

Datura tatula L. – kenophyte of North American origin, cosmopolitan area, diffuse, eutrophic, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roads and on the rubbish dump (Fig. 5B).

Solanum schultesii Opiz. – kenophyte of Western European origin, Euro-Mediterranean-Asian area, diffuse, mesotrophe, heliophyte, mesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, on the vegetable patch (Fig. 5C).

Lindernia procumbens (Krock.) Borbás – kenophyte of unexplained origin, Holarctic origin, diffuse, mesotrophe, heliophyte, hygrophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, disturbed places (Fig. 5D).

Melampyrum cristatum L. – kenophyte of Mediterranean origin, European area, diffuse,

eutrophic, sciopheliophyte, mesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, in meadows (Fig. 5E).

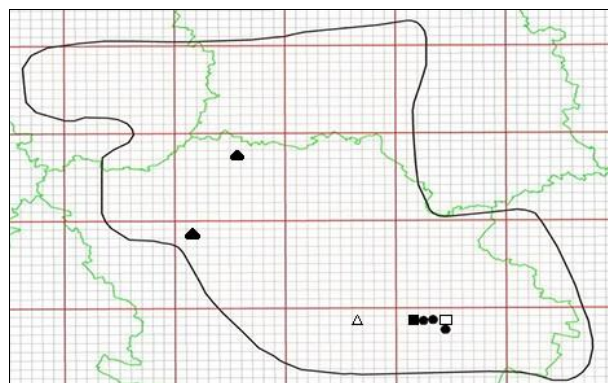


Fig. 5. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Astrodaucus orientalis* (L.) Drude; B. ▲ - *Datura tatula* L.; C. △ - *Solanum schultesii* Opiz.; D. □ - *Lindernia procumbens* (Krock.) Borbás; E. ■ - *Melampyrum cristatum* L.

Helianthus annuus var. *macrocarpus* (DC.) Cockerell – kenophyte of North American origin, European-American area, diffuse, eutrophic, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=22, along roadsides and railways (Fig. 6).

Petasites spurius (Retz.) Rchb. – kenophyte of Euro Siberian origin, European-North American-Forward-Asian area, local, eutrophic, sciopheliophyte, hygrophyte, hemicryptophyte, herbaceous polycarpous plant, I-Rank=0, on sands along the banks of rivers (Fig. 7A).

Xanthium ripicola Holub x *Xanthium albinum* (Widder.) H.Scholz. – kenophyte of hybridogenic origin, European area, belt, eutrophic, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roads (Fig. 7B).

Echinochloa tzvelevii Mosyakin ex Mavrodiev & H.Scholz – kenophyte of North-Eastern-European

origin, Central-European-North-American area, diffuse, eutrophic, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roadsides (Fig. 7C).

Panicum capillare L. – kenophyte of North American origin, Euro-Mediterranean-Asian area, local, mesotrophe, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roadsides (Fig. 7D).

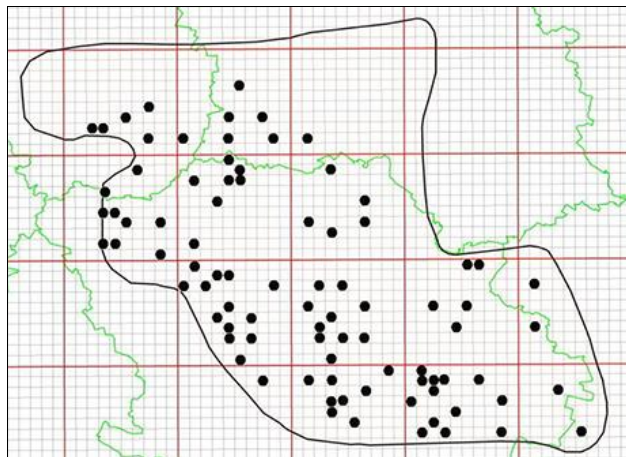


Fig. 6. The distribution of *Helianthus annuus* var. *macrocarpus* (DC.) Cockerell in the Romensko-Poltavsky Geobotanical District

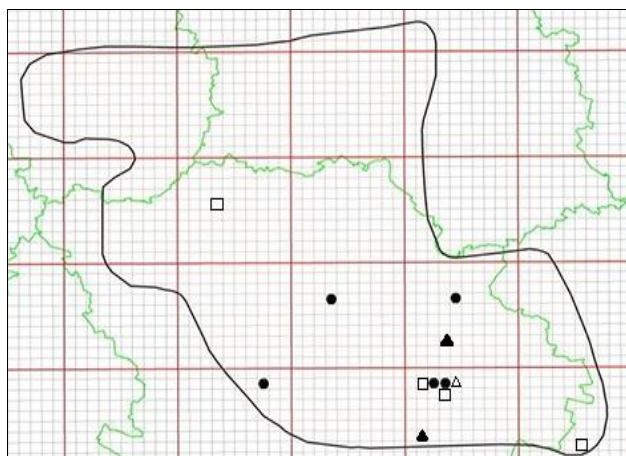


Fig. 7. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Petasites spurius* (Retz.) Rchb.; B. ▲ - *Xanthium ripicola* Holub × *Xanthium albinum* (Widder.) H. Scholz; C. ▲ - *Echinochloa tzvelevii* Mosyakin ex Mavrodiev & H. Scholz; D. □ - *Panicum capillare* L.

Phalaris canariensis L. – kenophytes of Mediterranean origin, cosmopolitan area, local, eutrophic, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roads and on the rubbish dump (Fig. 8A).

Panicum capillare L. subsp. *barvipulvinatum* (Nash) Tzvelev – kenophyte of North American origin, cosmopolitan area, local, mesotrophe, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, along roadsides (Fig. 8B).

Setaria verticilliformis Dumort. (*Setaria × ambigua* (Guss.) Guss.) – kenophyte of hybridogenic origin, cosmopolitan area, diffuse, mesotrophe, heliophyte, xeromesophyte, therophyte, herbaceous monocarpic plant, I-Rank=0, in gardens and in the vegetable patch (Fig. 8C).

Sorghum halepense (L.) Pers. – kenophyte of Mediterranean origin, cosmopolitan area, focal, mesotrophe, heliophyte, xeromesophyte, hemi-cryptophyte, herbaceous polycarpous plant, I-Rank=0, along roadsides, railways, in fields and gardens (Fig. 8D).

The habitats of ephemerophytes were analyzed and found that within the R-PGD territory the studied group of plants were mainly distributed in semi-natural (S) and man-made (H) habitats, seldom – in natural (N) ones. This distribution is also characteristic of ephemerophytes of Poland and the Czech Republic (PYŠEK ET AL., 2002; URBISZ, 2011). For example, *Onobrychis viciifolia* grows in N and S habitats within our territory and in the Czech Republic; species of *Panicum*, *Sorghum halepense* in H habitats.

When analyzing distribution maps of ephemerophytes within the R-PGD territory, it was noted that most species are distributed in single localities, except *Onobrychis viciifolia* and *Helianthus annuus* var. *macrocarpus*. Annual field research of the distribution of ephemerophytes does not always provide confirmation of the existing localities.

Similar studies on ephemerophytes were conducted in Poland (URBISZ, 2011), thus some information can be compared. In our research we determined that the ephemerophytes include 27 species. In taxonomic composition first two positions have *Poaceae* and *Asteraceae* family which is typical for the flora of Poland (URBISZ, 2011).

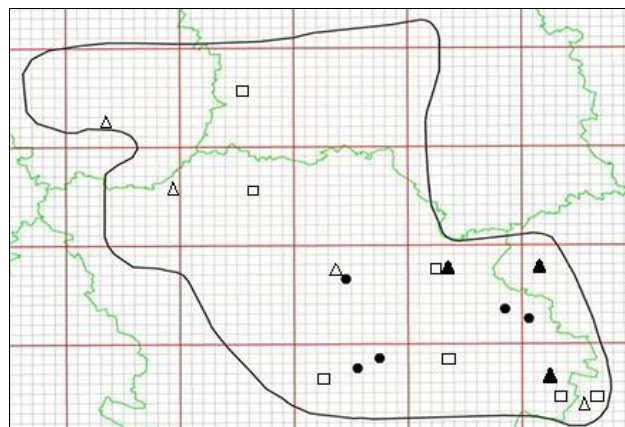


Fig. 8. The distribution of selected ephemerophytes in the Romensko-Poltavsky Geobotanical District: A. ● - *Phalaris canariensis* L.; B. ▲ - *Panicum capillare* L. subsp. *barvipulvinatum* (Nash) Tzvelev; C. ▲ - *Setaria verticilliformis* Dumort.; D. □ - *Sorghum halepense* (L.) Pers.

Generally the data collected confirm and complement the common patterns characteristic of ephemerophytes in certain regions – Volyn Polissya (OITSIUS, 2011), Starobilsk grass-meadow steppe (KUCHER, 2016), right-bank steppe Pridneprovya (KUCHEREVSKY, 2004), and within the Ukraine in general (PROTOPPOVA, 1991), which are observed in predominance in this group of kenophytes of Mediterranean origin, species of arid areas, cosmopolitans, species with diffuse type of spatial structure of distribution, herbaceous monocarpic plant, mesotrophes, heliophytes and xeromesophytes, with an insignificant impact on plant communities and of limited distribution in the study region.

4. Conclusion

This was the first comprehensive analysis of ephemerophytes in the territory of the Romensko-Poltavsky Geobotanical District within the Ukraine. We analyzed in detail the distribution maps and established that all ephemerophytes are distributed along roadsides and railways, near fields, farmland and household plots – in open places with densified soil. Some species are listed from time to time in the territory because they enter accidentally.

It should be noted that ephemerophytes is a separate group of plants of the alien portion of the flora because they are clearly different from other groups of plants due to their level of naturalization, character of entry and distribution in the territory.

In general the main role of ephemerophytes is to enrich the species composition of the flora. The summary of these results indicates that ephemerophytes are temporary and constitute an unstable component of the flora but require more detailed research and monitoring at the regional level and within the Ukraine in general.

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