

Plant Composition in Grasslands and Field Margins in Agroecosystems of South Bulgaria

Kiril H. Stoyanov, Tsvetanka G. Raycheva*

Agricultural University – Plovdiv, 12 Mendeleev Blvd., 4000 - Plovdiv, BULGARIA

*Corresponding author: nomtax@gmail.com

Abstract. The flora of the Thracian Lowland region was analyzed in 13 target localities (semi-natural grasslands) near rapeseed fields for a 3-year period. A total of 245 flowering species were registered in the experimental fields, 178 of them were entomophilic plant species. Eleven adventitious and invasive species were recorded in representative experimental fields and their margin. The share of adventive species are small percent of the species composition, but pose a future threat to biodiversity. Maintaining the relative naturalness of these areas has a big role in the nutrition for the pollinators. This study provides data about the identification, observation in the field margins. The collected data could be a base for evaluation of the ecosystem services provided by agroecosystems and neighboring semi-natural grasslands in the Thracian Lowland.

Key words: field margins, plant diversity, Thracian Lowland.

Introduction

The global biodiversity is threatened by the increased anthropogenic activities (Darkoh, 2003; Wessels et al., 2003). The recent studies have shown the link between the functioning of grassland ecosystems and the provision of a range of services that are essential to each community and its development (Altieri & Nicholls, 1999; Forest et al., 2017). The range of functions that an agroecosystem can support is closely linked to its biodiversity (Altieri, 1987, 1994). This large-scale transformation of natural vegetation presents a serious and growing threat to the biodiversity (Darkoh, 2003; Wessels et al., 2003).

One of the main priorities of the Common Agricultural Policy after 2003 in Bulgaria is the preservation of permanent pastures as a resource that has a positive

impact on the environment. Most of the permanent pastures in Bulgaria are predominantly semi-natural, i.e. have not been sown and fertilized in recent years. They are one of the most valuable ecosystems in the country's agricultural landscape, on the one hand because of their exceptional role in biodiversity conservation compared to other land uses, and on the other, they are particularly important for the soil conservation.

The semi-natural permanent grasslands consist of different types of vegetation - some with mostly grassland communities, while in others shrubs predominate, even in some cases tree species. In many cases, shrubs and trees are an integral part of permanent grassland, providing additional opportunities for grazing. In 2012, the permanent grasslands occupied 32.15% of

the utilized agricultural area in Bulgaria. Compared to the last years, there is a significant decrease in the area of permanent grassland, as compared to 2006 the permanent grassland decreased by 12.2%, at the expense mainly of the increased area of arable land, which increased by 6.6%. The most important plant species in the natural and renovated pastures are legumes and herbs (data from European Environment Information and Observation Network).

The ecological management of agroecosystems in Bulgaria is still poorly developed, so this study is a part of the ecosystem assessment that reflects the links between habitat management and plant diversity in rapeseed fields in the Thracian Lowland as a model approach aiming at sustainable management of agroecosystems, and maintaining semi-natural areas adjacent to permanent cropland.

The objective of the present study was to assess the plant species and their importance for biodiversity in representative agricultural fields in the Thracian Lowlands and their periphery.

Material and Methods

The subject of study are 13 pre-selected target localities in southern Bulgaria, visited

4 times during the growing season (March-July), in the period 2016-2018 (Table 1). In addition to the composition of the plant species, the following information was reported for each plot: number of registered species, number of insect pollinating species and number of adventitious species. The origin of the adventive species is according to Assyov & Petrova (2012). Several species with cosmopolitan distribution were considered invasive, according to Petrova et al. (2012).

The data for the species diversity were done in squares of 1 m². In each field or pasture were selected 10 squares, located at equal intervals in the fields and grasslands. The sampling plots were located consistently 10 meters from the border inside the fields, and in the margin. The plots were marked as GPS coordinates and with pegs in each angle of the square. For each plot was prepared list of the species.

The sampling plots in the grassland were 10, with distance between them at least 10 meters.

The locations of the investigated fields are represented by MGRS coordinates (1x1 km). The data of each location is a result of the summation of the determined species in the sampling squares.

Table 1. Investigated localities in Southern Bulgaria.

Municipality	Settlement	MGRS coordinates	Altitude	Pastures
Brezovo	Zelenikovo	35TLG4095	340 m	5-10%
		35TLG3995	318 m	
		35TLG4194	292 m	
Maritsa	Kostievo	35TLG0373	175 m	1-5%
		35TLG0271	172 m	
		35TLG0470	156 m	
	Radinovo	35TLG0573	178 m	100 %
Saedinenie	Malak Chardak	35TLG0583	210 m	20%
		35TLG0483	205 m	
Rakovski	Stryama	35TLG2279	182 m	10%
	Momino Selo	35TLG2584	183 m	20%
Dimitrovgrad	Dobrich	35TLG7853	122 m	20%
	Stalevo	35TLG6556	170 m	5%

Result and Discussion

In the floristic analysis, total 245 species from 40 families were identified in the experimental plots (Table 3), and were classified 65 anemophilous (26,5%), 178 entomophilous (72,6%), and 2 hydrophilous (0,8%) species. Of these species 11 (4.5%) are considered as adventive and invasive.

The studied localities are with sporadic participation of bush vegetation, represented by: *Quercus cerris*, *Q. pedunculiflora*, *Q. robur*, *Carpinus orientalis*, *Crataegus monogyna*, *Pyrus pyraster*, *Prunus cerasifera*, *Prunus vulgaris*, *Paliurus spinachristi*, *Malus domestica*, *Rosa canina*, and the invasive species *Robinia pseudoacacia*, *Amorpha fruticosa*, *Ailanthus altissima*. The field margins are habitats of anthropogenic origin. For this reason, they do not show the appearance of a specific type of the habitat.

Like most agricultural landscapes, the studied territories are an interacting complex of arable fields, sporadic semi-natural habitats and anthropogenic infrastructure (roads, canals, substations, etc.). The large number of settlements in the investigated area is a prerequisite for the presence of a large number of adventive and invasive species. Eleven invasive species have been identified (Table 2) – *Ailanthus altissima*, *Datura stramonium*, *Erigeron annuus*, *E. bonariensis*, *E. canadensis*, *Oxalis corniculata*, *Phytolacca americana*, *Robinia pseudoacacia*, *Sorghum halepensis*, *Xanthium orientale* var. *italicum*, *X. spinosum*. Adventive non-invasive species are *Chenopodium album*, *Eleusine indica*, *Juglans regia*, *Medicago sativa*, *Portulaca oleracea*, *Solanum nigrum*. Along with them, single plants or groups of cultivated species, wintering as seeds from previous or adjacent agricultural productions, are found in the orchards: *Brassica napus*, *Helianthus annuus*, *Triticum durum*, *Zea mays*. The present survey

stresses the necessity of studies focused on the invasive plants and processes of plant invasions in the agricultural lands in different regions of Bulgaria.

A small part of the surveyed plots located at equal intervals along the route was permanently flooded by permanent irrigation canals (adjacent to villages of Dobrich and Stalevo villages). Aquatic macrophytes were found there: *Alisma plantago-aquatica*, *Echinochloa crus-gallii*, *Gratiola officinalis*, *Mentha aquatica*, *Phragmites australis*, *Typha angustifolia*.

Due to the rugged terrain, the highest floral diversity and the presence of semi-natural habitats of conservation importance are observed in the land of Zelenikovo. Accordingly, the intensively managed pastures in urbanized areas, such as fields and pastures in the villages of Kostievo and Radinovo, displayed lower levels of vegetation coverage. The floristic diversity in agroecosystems of the Upper Thracian Lowland is distinguished by the presence of species such as *Papaver rhoeas*, *Cynosurus cristatus* or *Achillea millefolium* and rich involvement of legumes, for example, with 15 to 25% coverage of *Trifolium* sp. and *Vicia* sp. species compared to 5% in conventional intensively exploited grasslands. The predominant species in the semi-natural grasslands are entomophilic, mainly Mediterranean, sub-Mediterranean and Eurocarpathian geoelements, whereas the boreal flora is mainly represented by anemophilous plants. This fact corresponds to an increase in habitats for major pollinators and supports the need to maintain more natural grasslands, since the decrease poses a threat to the services provided by the pollinators. A more complete understanding of the effect of grassland loss and species diversity could be obtained from studies on the behavior and numbers of pollinators (Wardle et al. 1999a; b).

Table 2. List of the adventive and invasive plants recorded on the whole studied territory.

Species	Origin	Status	Occurrence
<i>Ailanthus altissima</i> (Mill.) Swingle	China	Invasive	3
<i>Chenopodium album</i> L.	North America	Adventive	5
<i>Datura stramonium</i> L.	Central America	Invasive	1
<i>Eleusine indica</i> (L.) Gaertn.	Asia	Adventive	2
<i>Erigeron annuus</i> (L.) Pers.	North America	Invasive	7
<i>Erigeron bonariensis</i> L.	Central America	Invasive	2
<i>Erigeron canadensis</i> L.	North America	Invasive	4
<i>Fallopia convolvulus</i> (L.) A.Loeve	North America	Adventive?	2
<i>Helianthus annuus</i> L.	North America	Adventive	1
<i>Juglans regia</i> L.	Central Asia	Adventive	1
<i>Medicago sativa</i> L.	Central Asia	Adventive	3
<i>Oxalis corniculata</i> L.	Central and South America	Invasive	1
<i>Phytolacca americana</i> L.	North America	Invasive	1
<i>Portulaca oleracea</i> L.	North Africa and South Europe	Invasive	4
<i>Robinia pseudoacacia</i> L.		Invasive	1
<i>Solanum nigrum</i> L.		Adventive	1
<i>Sorghum halepensis</i> (L.) Pers.	Syria and Turkey	Invasive	2
<i>Xanthium orientale</i> subsp. <i>italicum</i> (Moretti) Greuter	South and North America	Invasive	1
<i>Xanthium spinosum</i> L.	South America	Invasive	1

Conclusions

The semi-natural grasslands in the Upper Thracian Lowland are anthropogenic habitats. The study confirms the existence of an expected link between floral diversity and the intensity of land management. The lowest floristic diversity and predominance of ruderal and weed elements were found in fragmented and highly urbanized habitats, such as in the region of villages of M. Chardak, Zelenikovo and Kostievo. This corresponds to the fragmentation of agricultural land and the dynamics of land use, which increases weed and ruderal plant species. The study provides data for the identification and monitoring of plant diversity, and is the basis for a future evaluation of ecosystem services provided by agrocoenoses and adjacent semi-natural grasslands in the Upper Thracian Lowland.

Acknowledgements

We acknowledge funding through Grant STACCATO, BiodivERsA-FACCE2014-47. The authors would like to

thank to the anonymous reviewers for their comments on the earlier versions of the manuscript.

References

- Assyov, B., & Petrova, A. (Eds.) (2012). *Conspectus of the Bulgarian Vascular Flora. Distribution maps and floristic elements*. Ed. 4. Bulgarian Biodiversity Foundation, Sofia. (In Bulgarian)
- Altieri, M.A. (1987). *Agroecology: the scientific basis of alternative agriculture*. Boulder: Westview Press.
- Altieri, M.A. (1994). *Biodiversity and pest management in agroecosystems*. Hayworth Press, New York.
- Altieri, M.A., & Nicholls, C.I. (1999). *Biodiversity, ecosystem function and insect pest management in agricultural systems*. In: W.W. Collins & C.O. Qualset (Eds.) *Biodiversity in Agroecosystems*. CRC Press, Boca Raton.
- Darkoh, M.B.K. (2003). *Agriculture and biodiversity in the drylands of Africa*.

- In - Darkoh, M.B.K., & Rwomire, A. (Eds.) *Human impact on environment and sustainable development in Africa*. Hampshire, England: Ashgate Publishing. p. 253-276.
- EEION. (2020). *European Environment Information and Observation Network*. Retrieved from eionet.europa.eu
- Forest, I., Adler, P., Eisenhauer, N., Fornara, D., Kimmel, K., Kremen, C., Letourneau, D., Liebman, M., Polley, H., Quijas, S. & Scherer-Lorenzen, M. (2017). Benefits of increasing plant diversity in sustainable agroecosystems. *Journal of Ecology*, 105, 871-879. doi: [10.1111/1365-2745.12789](https://doi.org/10.1111/1365-2745.12789).
- Petrova, A., Vladimirov, V. & Georgiev, V. (2012). *Invasive alien species of vascular plants in Bulgaria*. Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia.
- Pullin, A.S. (2002). *Conservation biology*. New York: Cambridge University Press.
- Wardle, D.A., Bonner, K.I., Barker, G.M., Yeates, G.W., Nicholson, K.S., Bardgett, R.D., Watson, R.N. & Ghani, A. (1999a). Plant removals in perennial grassland: Vegetation dynamics, decomposers, soil biodiversity, and ecosystem properties. *Ecological Monographs*, 69(4), 535-568. doi: [10.1890/0012-9615\(1999\)069\[0535:PRIPGV\]2.0.CO;2](https://doi.org/10.1890/0012-9615(1999)069[0535:PRIPGV]2.0.CO;2)
- Wardle, D.A., Nicholson, K.S., Bonner K.I., & Yeates, G.W. (1999b). Effects of agricultural intensification on soil-associated arthropod population dynamics, community structure, diversity and temporal variability over a seven-year period. *Soil Biology and Biochemistry*, 31(12), 1691-1706. doi: [10.1016/S0038-0717\(99\)00089-9](https://doi.org/10.1016/S0038-0717(99)00089-9)
- Wessels, K.J., Reyers, B., Van Jaarsveld, A.S., & Rutherford, M.C. (2003). Identification of potential conflict areas between land transformation and biodiversity conservation in north-eastern South Africa. *Agriculture, Ecosystems & Environment*, 95(1), 157-178. doi: [10.1016/S0167-8809\(02\)00102-0](https://doi.org/10.1016/S0167-8809(02)00102-0)

Received: 31.01.2020
Accepted: 30.07.2020

Plant Composition in Grasslands and Field Margins in Agroecosystems of South Bulgaria

Table 3. Identified species in the study plots represented by the MGRS coordinates (see Table 1 for description of the MGRS quadrants): ■ - entomophilous, ○ - anemophilous.

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>Achillea cf. millefolium</i> L.			■	■	■	■	■		■		■	■	■	■
<i>Aegilops cylindrica</i> Host						○	○		○					○
<i>Aegilops geniculata</i> Roth.		○				○								
<i>Agrimonia eupatoria</i> L.											■			■
<i>Agropyron cristatum</i> (L.) Gaertn.			○				○							
<i>Agrostis capillaris</i> L.		○				○								
<i>Ailanthus altissima</i> (Mill.) Swingle				■	■		■							
<i>Alopecurus myosuroides</i> Huds.														○
<i>Alopecurus pratensis</i> L.			○					○					○	
<i>Alyssum alyssoides</i> (L.) L.									■					
<i>Alyssum desertorum</i> Stapf		■												
<i>Anthemis arvensis</i> L.							■							
<i>Anthemis cotula</i> L.							■				■			
<i>Anthemis ruthenica</i> M.Bieb.						■	■		■		■		■	■
<i>Anthoxanthum aristatum</i> Boiss.									○				○	
<i>Anthoxanthum odoratum</i> L.			○				○							
<i>Arctium lappa</i> L.													■	
<i>Aristolochia clematitis</i> L.		■				■								
<i>Arrhenatherum elatius</i> (L.) P. Beauv. ex J. & C. Presl.		○	○				○		○				○	○
<i>Artemisia absinthium</i> L.					○							○		
<i>Artemisia vulgaris</i> L.								■						
<i>Asparagus officinalis</i> L.											■			
<i>Asperugo procumbens</i> L.			■											
<i>Astragalus monspessulanus</i> L.			■											
<i>Avena fatua</i> L.		○		○		○	○	○	○					
<i>Avena sativa</i> L.							○				○			
<i>Ballota nigra</i> L.		■				■								
<i>Bituminaria bituminosa</i> (L.) Stirt.									■					
<i>Brachypodium distachyon</i> (L.) P.Beauv.						○	○							
<i>Brachypodium pinnatum</i> (L.) P.Beauv.							○	○						
<i>Briza media</i> L.											○			
<i>Bromus arvensis</i> L.						○	○		○		○	○		
<i>Bromus commutatus</i> Schrad.							○		○		○			
<i>Bromus hordeaceus</i> L.			○		○	○		○	○			○	○	○
<i>Bromus inermis</i> Leyss.			○			○	○		○			○		○
<i>Bromus madritensis</i> L.											○	○		

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>Bromus racemosus</i> Huds.			○								○			
<i>Bromus squarrosus</i> L.			○											
<i>Bromus sterilis</i> L.		○	○				○				○			○
<i>Bromus tectorum</i> L.		○	○			○	○	○	○		○			○
<i>Calamagrostis arundinacea</i> (L.) Roth.												○		
<i>Calamagrostis epigeios</i> (L.) Roth.									○					
<i>Calepina irregularis</i> (Asso) Thell.				■										
<i>Campanula sparsa</i> Friv.											■			
<i>Capsella bursa-pastoris</i> (L.) Medicus	■			■	■				■		■	■	■	■
<i>Carduus acanthoides</i> L.	■						■							
<i>Centaurea alba</i> L.			■		■							■		
<i>Centaurea diffusa</i> Lam.			■											
<i>Centaurea solstitialis</i> L.													■	■
<i>Chenopodium album</i> L.		○					○		○		○		○	
<i>Cichorium intybus</i> L.	■												■	■
<i>Cirsium arvense</i> (L.) Scop.							■	■	■		■	■		■
<i>Cirsium vulgare</i> (Savi) Ten.			■											
<i>Conium maculatum</i> L.				■									■	
<i>Consolida regalis</i> S. F. Gray			■											
<i>Convolvulus arvensis</i> L.	■	■	■	■			■	■	■		■	■	■	■
<i>Cota altissima</i> (L.) J. Gay									■					
<i>Cota austriaca</i> (Jacq.) Sch.Bip.								■					■	■
<i>Cota tinctoria</i> (L.) J. Gay											■		■	
<i>Crepis foetida</i> L.			■											
<i>Crepis setosa</i> Hall. f.												■		
<i>Cruciata glabra</i> (L.) Ehrend.													■	
<i>Cruciata laevipes</i> Opiz							■		■		■			
<i>Cyanus segetum</i> Hill								■	■				■	
<i>Cynodon dactylon</i> (L.) Pers.			○				○				○	○	○	○
<i>Cynoglossum montanum</i> L.								■						
<i>Cynosurus echinatus</i> L.									○		○			
<i>Dactylis glomerata</i> L.			○											
<i>Dasypyrum villosum</i> (L.) Borb.		○					○	○	○					
<i>Deschampsia caespitosa</i> (L.) P.Beauv.			○											
<i>Descurainia sophia</i> (L.) Webb.	■					■	■							
<i>Dianthus corymbosus</i> Sm.								■			■			■
<i>Eleusine indica</i> (L.) Gaertn.									○		○			
<i>Equisetum arvense</i> L.									+					
<i>Equisetum palustre</i> L.									+		+			
<i>Erigeron annuus</i> (L.) Pers.	■	■	■	■	■	■	■			■				

Plant Composition in Grasslands and Field Margins in Agroecosystems of South Bulgaria

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>Erigeron bonariensis</i> L.				○	○							○		
<i>Erigeron canadensis</i> L.	○					○	○							○
<i>Erodium cicutarium</i> (L.) L'Her.							■	■	■		■			■
<i>Eruca vesicaria</i> (L.) Cav.											■			
<i>Eryngium campestre</i> L.							■	■	■	■	■	■	■	
<i>Erysimum diffusum</i> Ehrh.								■						
<i>Euphorbia cyparissias</i> L.								■	■	■	■			
<i>Euphorbia helioscopia</i> L.	■				■			■					■	
<i>Fallopia convolvulus</i> (L.) A.Loeve			■								■			
<i>Festuca arundinacea</i> Schreb.									○					
<i>Festuca pratensis</i> Huds.								○					○	
<i>Filago arvensis</i> L.	■											■		
<i>Filago lutescens</i> Jord.					■							■		
<i>Filipendula vulgaris</i> Moench									■		■		■	■
<i>Foeniculum vulgare</i> Mill.								■			■			
<i>Fritillaria pontica</i> Wahlenb.										■				
<i>Galium album</i> Mill.							■		■					
<i>Galium aparine</i> L.									■		■		■	■
<i>Gallium verum</i> L.			■						■			■		■
<i>Geranium columbinum</i> L.													■	
<i>Geranium dissectum</i> L.	■					■	■	■	■			■		■
<i>Geranium molle</i> L.	■	■				■	■	■	■			■		
<i>Geranium rotundifolium</i> L.							■				■		■	
<i>Gratiola officinalis</i> L.												■	■	
<i>Helianthus annuus</i> L.			■											
<i>Helminthotheca echioides</i> (L.) Holub.			■											
<i>Hieracium</i> spp.										■			■	
<i>Hordeum marinum</i> Huds.							○	○						
<i>Hordeum murinum</i> L.	○	○	○			○				○	○	○	○	
<i>Hypocoum pendulum</i> L.								■						
<i>Hypericum perforatum</i> L.											■			
<i>Inula aspera</i> Poir.			■											
<i>Lactuca hispida</i> DC.							■		■					
<i>Lactuca serriola</i> L.	■	■				■	■	■	■		■	■	■	■
<i>Lamium amplexicaule</i> L.													■	
<i>Lamium purpureum</i> L.	■									■				
<i>Lathyrus aphaca</i> L.														■
<i>Lathyrus hirsutus</i> L.													■	
<i>Lathyrus latifolius</i> L.													■	
<i>Lathyrus nissolia</i> L.														■
<i>Lathyrus sativus</i> L.														■

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>Lepidium campestre</i> (L.) R.Br.									■		■			
<i>Lepidium draba</i> L.		■		■				■				■		
<i>Linaria dalmatica</i> (L.) Mill.												■		
<i>Linaria genistifolia</i> (L.) Mill.								■			■			
<i>Linaria vulgaris</i> Mill.									■					
<i>Lolium multiflorum</i> Lam.									○			○		
<i>Lolium perenne</i> L.		○	○	○		○	○	○	○		○			
<i>Lolium remotum</i> Schrank						○	○							
<i>Lolium rigidum</i> Gaudin					○		○		○		○	○		
<i>Lolium temulentum</i> L.					○		○					○		
<i>Lotus corniculatus</i> L.			■		■			■						
<i>Malva sylvestris</i> L.		■		■		■		■						
<i>Marrubium vulgare</i> L.								■						
<i>Matricaria chamomilla</i> L.		■		■		■	■	■	■		■			
<i>Medicago arabica</i> (L.) Huds.							■							
<i>Medicago minima</i> (L.) Bartal.			■		■		■						■	■
<i>Medicago orbicularis</i> (L.) Bartal													■	■
<i>Medicago rigidula</i> (L.) All.					■		■	■					■	■
<i>Medicago sativa</i> L.		■				■							■	
<i>Melilotus officinalis</i> (L.) Pall.													■	
<i>Mentha arvensis</i> L.			■											
<i>Moehringia trinervia</i> (L.) Clairv.					■									
<i>Moenchia mantica</i> (L.) Bartl.								■					■	
<i>Muscari botryoides</i> (L.) Mill.										■				
<i>Nigella arvensis</i> L.			■											
<i>Nonea atra</i> Griseb.														■
<i>Ononis spinosa</i> L.			■											
<i>Orchis purpurea</i> Huds.										■				
<i>Orlaya daucorlaya</i> Murb.													■	
<i>Orlaya grandiflora</i> (L.) Hoffm.											■			
<i>Ornithogalum boucheanum</i> Asch.										■				
<i>Ornithogalum umbellatum</i> L.													■	
<i>Paliurus spina-christi</i> Mill.											■			
<i>Papaver dubium</i> L.													■	
<i>Papaver hybridum</i> L.				■			■							
<i>Papaver rhoeas</i> L.		■		■		■	■	■	■		■	■	■	■
<i>Parentucellia latifolia</i> (L.) Caruel								■					■	
<i>Phleum exaratum</i> Griseb.			○											
<i>Pilosella caespitosa</i> (Dumort.) P.D.Sell & C.West												■		
<i>Pisum sativum</i> subsp. <i>elatius</i>														■

Plant Composition in Grasslands and Field Margins in Agroecosystems of South Bulgaria

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
(M. Bieb.) Asch. & Graebn.														
<i>Plantago lanceolata</i> L.	○	○	○				○		○		○	○	○	○
<i>Poa annua</i> L.		○				○	○					○	○	○
<i>Poa bulbosa</i> L.						○	○			○			○	
<i>Poa pratensis</i> L.	○	○				○	○					○	○	
<i>Podospermum laciniatum</i> (L.) DC.	■			■					■		■	■	■	
<i>Polygonum aviculare</i> L.	○	○	○	○	○	○		○			○	○		
<i>Portulaca oleracea</i> L.				■	■					■				■
<i>Potentilla argentea</i> L.									■		■	■		
<i>Potentilla inclinata</i> Vill.											■		■	■
<i>Potentilla reptans</i> L.			■				■	■						
<i>Prunus cerasifera</i> Ehrh.	■	■	■			■								
<i>Ranunculus acris</i> L.														■
<i>Ranunculus arvensis</i> L.										■	■		■	■
<i>Ranunculus illyricus</i> L.										■				
<i>Ranunculus pedatus</i> Waldst. & Kit.													■	
<i>Ranunculus repens</i> L.													■	
<i>Raphanus raphanistrum</i> L.	■							■						
<i>Rorippa lippizensis</i> (Wulfen) Rchb.											■			
<i>Rorippa pyrenaica</i> (L.) Rchb.													■	
<i>Rorippa sylvestris</i> (L.) Besser	■										■			
<i>Rosa spinosissima</i> L.														■
<i>Rumex acetosa</i> L.							○						○	
<i>Rumex acetosella</i> L.									○				○	
<i>Rumex conglomeratus</i> Murray			○											
<i>Rumex crispus</i> L.	○	○	○					○					○	
<i>Rumex crispus</i> × <i>R. pulcher</i>	○		○											
<i>Rumex palustris</i> Sm.				○										
<i>Rumex pulcher</i> L.				○			○	○			○	○		
<i>Salix alba</i> L.													■	
<i>Sambucus ebulus</i> L.								■						■
<i>Sanguisorba minor</i> Scop.								○		○				○
<i>Scleranthus annuus</i> L.									■	■				
<i>Sclerochloa dura</i> (L.) P. Beauv.							○							
<i>Scolymus hispanicus</i> L.	■			■	■	■	■				■	■	■	
<i>Scolymus maculatus</i> L.					■						■	■		
<i>Serratula tinctoria</i> L.	■													
<i>Sherardia arvensis</i> L.													■	■
<i>Sisymbrium officinale</i> (L.) Scop.	■			■		■					■	■		
<i>Solanum nigrum</i> L.			■											

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>Sonchus oleraceus</i> L.		■											■	
<i>Sorghum halepensis</i> (L.) Pers.			■										■	
<i>Stellaria media</i> (L.) Vill.								■					■	
<i>Taeniatherum caput-medusae</i> (L.) Nevski												■		
<i>Taraxacum cf. officinale</i> F. H. Wigg							■						■	■
<i>Thlaspi alliaceum</i> L.													■	
<i>Thlaspi arvense</i> L.									■				■	■
<i>Thymus striatus</i> Vahl											■			
<i>Tragopogon dubius</i> Scop.	■			■			■	■	■		■	■		
<i>Trifolium arvense</i> L.	■	■							■			■		
<i>Trifolium bocconeii</i> Savi												■		
<i>Trifolium campestre</i> Schreb.												■		
<i>Trifolium cherleri</i> L.													■	
<i>Trifolium echinatum</i> M. Bieb.													■	
<i>Trifolium hybridum</i> L.	■			■	■	■						■	■	
<i>Trifolium incarnatum</i> L.											■			
<i>Trifolium medium</i> L.												■		■
<i>Trifolium nigrescens</i> Viv.	■						■		■		■	■	■	■
<i>Trifolium pratense</i> L.	■						■							
<i>Trifolium repens</i> L.	■	■	■	■	■		■	■				■	■	■
<i>Trifolium striatum</i> L.	■				■	■	■	■			■	■	■	
<i>Trifolium vesiculosum</i> Savi							■							■
<i>Trigonella caerulea</i> (L.) Ser.						■								
<i>Tripleurospermum inodorum</i> (L.) Sch.Bip.						■		■	■		■	■	■	■
<i>Triticum durum</i> Desf.												○		
<i>Valerianella dentata</i> (L.) Pollich												■		
<i>Verbascum phoeniceum</i> L.												■		
<i>Verbena officinalis</i> L.			■											
<i>Veronica hederifolia</i> L.								■						
<i>Vicia cassubuca</i> L.													■	
<i>Vicia cracca</i> L.				■		■	■	■				■	■	
<i>Vicia grandiflora</i> Scop.	■					■		■	■		■	■	■	
<i>Vicia hirsuta</i> (L.) Gay	■				■	■		■	■		■	■	■	■
<i>Vicia narbonensis</i> L.										■			■	■
<i>Vicia pannonica</i> Crantz subsp. <i>pannonica</i>	■		■						■				■	■
<i>Vicia pannonica</i> subsp. <i>striata</i> (M.Bieb.) Ponert									■	■				
<i>Vicia sativa</i> L.	■				■	■						■		■
<i>Vicia tenuifolia</i> subsp. <i>dalmatica</i> (A. Kern.) Greuter											■			
<i>Vicia tenuifolia</i> Roth. subsp.											■			

Plant Composition in Grasslands and Field Margins in Agroecosystems of South Bulgaria

	35TLG	0271	0373	0470	0483	0573	2279	2584	3995	4095	4194	0583	6556	7853
<i>tenuifolia</i>														
<i>Vicia villosa</i> Roth.							■		■				■	
<i>Vinca minor</i> L.										■				
<i>Viola arvensis</i> Murray					■							■		
<i>Viola tricolor</i> L.											■			
<i>Vitis vinifera</i> L.														■
<i>Vulpia myuros</i> (L.) C.C.Gmel.								○	○			○		
<i>Xanthium orientale</i> subsp. <i>italicum</i> (Moretti) Greuter			■											
<i>Xanthium spinosum</i> L.			■											
Total number of species	58	54	27	26	44	71	52	63	20	69	60	78	59	