Acta Agrobotanica

ORIGINAL RESEARCH PAPER Acta Agrobot 68(3):197–203 DOI: 10.5586/aa.2015.022
Received: 2014-10-20 Accepted: 2015-08-28 Published electronically: 2015-10-21

Flora in abandoned fields and adjacent crop fields on rendzina soils in the Zamość region

Marta Ziemińska-Smyk, Teresa Grażyna Wyłupek*, Barbara Skwaryło-Bednarz
Department of Plant Biology, Faculty of Agricultural Sciences in Zamość, University of Life Sciences in Lublin, Szczebrzeska 102, 22-400 Zamość, Poland

Abstract

A floristic inventory of segetal flora was carried out in abandoned fields and adjacent crop fields on rendzina soils in the Zamość region in the year 2010. This study found a total of 130 weed species belonging to 30 botanical families. The following families were represented most frequently: Asteraceae, Fabaceae, Poaceae, Lamiaceae, Scrophulariaceae, and Brassicaceae. In the segetal flora, apophytes are dominant (55% of the total flora), with the highest number of meadow and xerothermic grassland species among them. Archeophytes (38%) predominate in the group of anthropophytes. The species characterized by the highest constancy classes and reaching the highest cover indices posed the greatest threat to crops in the study area. The following weeds are most frequently found in fallow fields: *Consolida regalis*, *Cichorium intybus*, and *Sinapis arvensis*, while *Papaver rhoeas* is the greatest threat to cereal crops grown on rendzina soils.

Keywords: segetal weeds; botanical families; abandoned fields; Zamość region

Introduction

At the turn of the 20th and 21st centuries, Polish agriculture was characterized by a continuous process of changes both in the ownership structure and in land use directions [1]. In 2002 the area of set-aside and fallow land in Poland was 2.3 million ha, which accounts for 19.7% of arable land area [2]. In Lubelskie Voivodeship (province), the low profitability of agricultural production and difficulties with selling agricultural products produced in farms have resulted in an intensification of the process of setting aside and fallowing arable land. In 1999 a total of 71 100 ha of arable land was set aside or fallowed, which accounted for 5.3% of its total area. Until 2003 there was a significant increase in the area of set-aside and fallow land, which was 92 800 ha, i.e., 8% of arable land area. The abandonment of agricultural production in crop fields involves various risks, including the undesired and uncontrolled appearance of agricultural pests [3]. Vegetation growing in set-aside land flowers, bears fruit, matures and produces seeds that get into the soil and can maintain viability for many years. Apart from that, the seeds of anemochores can migrate to adjacent crop fields or can be carried over large distances [4,5]. Wasteland and set-aside land undergoing secondary succession are often considered to be a source of weed infestation of crop fields [6–8]. In the first years after fields cease to be cultivated, annual weeds and species that occurred in the last cultivated crop grow predominantly in such fields [9,10]. Younger abandoned fields have more favorable conditions for weed growth than crop stands or stubble fields. Weeds in abandoned fields can use habitat resources throughout the entire growing season. They have a lot of room and unlimited access to light. Their growth is not disturbed by the crop plant dominant in the field and by agronomic treatments used [11]. Weeds can reach larger sizes and produce more seeds. Therefore, much more fruits and seeds are found in the topsoil of an abandoned field than in a cultivated field [12,13]. In addition to secondary succession that leads to the restoration of vegetation characteristic of a given type of habitat, other adverse ecological processes also take place in set-aside land and nitrogen leaching and erosion can be included in them [6,14]. The early stages of setting aside land diminish the aesthetic qualities of landscape and moreover biocoenoses in abandoned fields lead to the accumulation of diaspores of segetal and ruderal weeds as well as of crop pests and diseases [7,12,15,16]. Anemochorous weeds found in set-aside land are an enormous threat to crop plants that are grown in its vicinity [17,18]. The presence of runners of couch grass and perennial weeds causes heavy topsoil sodding and hinders the restoration of a field to agricultural use [14]. Therefore, an abandoned field brings about the need to increase crop protection in neighboring farmland [19].

The growth of vegetation in set-aside land depends primarily on natural ecological factors, among which soil plays an important role (inter alia, its granulometric composition, nutrient availability, pH), while secondary succession

* Corresponding author. Email: teresawylupek@op.pl
Handling Editor: Elżbieta Weryszko-Chmielewska

proceeds in the direction of replacement communities for a given habitat [15,20].

The aim of the present study was to compare weed infestation in abandoned fields and adjacent crop fields on rendzina soils in the Zamość region and to identify segetal species that are the greatest threat to crop fields.

Material and methods

The study of weed infestation in abandoned fields and adjacent crop fields was conducted in cereal crop fields in the villages of Brody Duże and Niedzielska located in the municipality of Szczebrzeszyn as well as in the village of Borowina Sitaniecka in the municipality of Stary Zamość. In the study, 22 relevés made in 2010 using the Braun-Blanquet method were compared [21].

The constancy class (S), i.e., the percentage of occurrence of a particular species in the relevés of a given association expressed using a five-point scale (I–V), was calculated for each species. The cover index (D), which denotes the average cover of a species in the relevés multiplied by 100 [21], was also determined. Plant species nomenclature follows Mirek et al. [22]. The soil type and soil complexes in terms of agricultural usefulness were determined based on agricultural soil maps at a scale of 1:5000 [23].

Results

Weed infestation in abandoned fields on rendzina soils

Based on 10 relevés, 11 weed species were found in abandoned fields on rendzina soils. Weeds of the highest constancy classes and cover indices determine the characteristics of agrophytocenoses in set-aside land. Fourteen species classified in constancy classes V and IV with a high cover index had a major contribution to weed infestation in abandoned fields (Tab. 1). The following species were dominant contributors to weed infestation in abandoned fields on rendzina soils: *Taraxacum officinale*, *Daucus carota*, *Melilotus officinalis*, *Elymus repens*, *Campanula rapunculoides*, *Papaver rhoeas*, *Consolida regalis*, *Medicago lupulina*, *Matricaria maritima* subsp. *inodora*, *Cichorium intybus*, *Convolvulus arvensis*, *Avena fatua*, *Sonchus arvensis*, and *Cirsium arvense* (Tab. 1). Nearly 60% (i.e., 84) of all species (Tab. 2), were classified in low constancy classes (I–II).

The segetal flora in abandoned fields belongs to 29 botanical families. In terms of the number of species, the richest families are as follows: Asteraceae, Fabaceae, Poaceae, Lamiaceae, Scrophulariaceae, Brassicaceae, Caryophyllaceae, Euphorbiaceae, Boraginaceae, and Apiaceae. Three species were included in each of the following families: Ranunculaceae, Polygonaceae, Geraniaceae, and Rubiaceae.

The species-richest genera are the following: *Euphorbia* – 5 species, *Vicia* – 3 species, *Veronica* – 3 species, *Sonchus* – 3 species, and *Centaurea* – 3 species.

In abandoned fields, they are represented by 66 species, which accounts for 59% of the total recorded flora (Fig. 1). Meadow species (24–35%), followed by xerothermic grassland species (23–35%), are dominant among various groups

Tab. 1 Weeds found on fallow fields and in cereal crops on rendzina soils in the Zamość region, according to the constancy class (S).

Species	Family	Fallow S	Cereal crops
Papaver rhoeas	Papaveraceae, arch.	V	V
Consolida regalis	Ranunculaceae, arch.	V	V
Campanula rapunculoides	Campanulaceae, ap. xer.	V	III
Taraxacum officinale	Asteraceae, ap. m.*	V	II
Daucus carota	Apiaceae, ap. m.	V	II
Melilotus officinalis	Fabaceae, ap. m.	V	II
Medicago lupulina	Fabaceae, ap. xer.	V	II
Matricaria maritima subsp. *indora*	Asteraceae, arch.	V	II
Elymus repens	Poaceae, ap. w.	V	I
Convolvulus arvensis	Convolvulaceae, arch.	IV	V
Cirsium arvense	Asteraceae, ap. f.	IV	III
Avena fatua	Poaceae, arch.	IV	III
Sonchus arvensis	Asteraceae, ap. w.	IV	II
Cichorium intybus	Asteraceae, arch.	IV	II
Galium aparine	Rubiaceae, ap. f.	III	V
Lathyrus tuberosus	Fabaceae, arch.	III	IV
Sinapis arvensis	Brassicaceae, arch.	III	IV
Anagallis arvensis	Primulaceae, arch.	III	IV
Myosotis arvensis	Boraginaceae, arch.	III	III
Viola arvensis	Violaceae, arch.	III	III
Melampyrum arvense	Scrophulariaceae, arch.	III	I
Pastinaca sativa	Apiaceae, ap. m.	III	I
Cerinthe minor	Boraginaceae, ap. xer.	III	I
Sonchus asper	Asteraceae, arch.	III	I
Vicia hirsuta	Fabaceae, arch.	III	I
Lactuca serriola	Asteraceae, arch.	III	I
Linaria vulgaris	Scrophulariaceae, ap. f.	III	I
Melandrium noctiflorum	Caryophyllaceae, ap. m.	II	IV
Veronica persica	Scrophulariaceae, ep.	II	IV
Polygonum aviculare	Polygonaceae, ap. w.	II	III
Valerianella denata	Valerianaceae, arch.	II	III
Fallopia convolvulus	Polygonaceae, ap. m.	II	III
Medicago falcata	Fabaceae, ap. xer.	II	III
Vicia angustifolia	Fabaceae, arch.	II	II
Euphorbia exigua	Euphorbiaceae, arch.	II	II
Salvia verticillata	Lamiaceae, ap. xer.	II	II
Knautia arvensis	Dipsacaceae, ap. m.	II	II
Achillea millefolium	Asteraceae, ap. m.	II	II
Falcaria vulgaris	Apiaceae, ap. xer.	II	II

Tab. 1 *(continued)*

Species	Family	Fallow S	Cereal crops
Centaurea scabiosa	Asteraceae, ap. xer.	II	I
Tussilago farfara	Asteraceae, ap. f.	II	I
Melandrium album	Caryophyllaceae, ap. xer.	II	I
Erodium cicutarium	Geraniaceae, arch.	II	I
Apera spica-venti	Poaceae, arch.	II	I
Centaurea cyanus	Asteraceae, arch.	II	I
Sonchus oleraceus	Asteraceae, arch.	II	I
Stachys palustris	Lamiaceae, a. m.	II	I
Adonis aestivalis	Ranunculaceae, arch.	II	I
Arenaria serpyllifolia	Caryophyllaceae, ap. xer.	II	I
Artemisia vulgaris	Asteraceae, ap. f.	II	I
Dactylis glomerata	Poaceae, ap. m.	II	I
Hypericum perforatum	Hypericacee, ap. m.	II	-
Coronilla varia	Fabaceae, ap. xer.	II	-
Chenopodium album	Chenopodiaceae, ap. w.	I	IV
Euphorbia helioscopia	Euphorbiaceae, arch.	I	III
Lapsana communis	Asteraceae, ap. f.	I	III
Veronica polita	Scrophulariaceae, arch.	I	II
Aethusa cynapium	Apiaceae, arch.	I	II
Stellaria media	Caryophyllaceae, ap. m.	I	II
Lamium amplexicaule	Lamiaceae, arch.	I	II
Galeopsis tetrahit	Lamiaceae, ap. f.	I	II
Trifolium repens	Fabaceae, ap. m.	I	II
Capsella bursa-pastoris	Brassicaceae, arch.	I	II

Explanations: ap. m. – apophytes meadows, ap. xer. – apophytes xerothermic grasslands, ap. w. – apophytes waterside, ap. f. – apophytes forest, arch. – archeophytes, ep. – epecophytes. Species included in constancy classes in both fallows and cereal crops: *Allium vineale*, *Bromus secalinus*, *Echium vulgare*, *Erigeron acris*, *Fumaria officinalis*, *Glechoma hederacea*, *Muscari comosum*, *Sherardia arvensis*. Species included in constancy classes in fallows: *Agrimonia procera*, *Avena sativa*, *Bromus inermis*, *Camelina microcarpa*, *C. sativa*, *Centaurea rhenana*, *Cerastium vulgatum*, *Crepis tectorum*, *Descurainia sophia*, *Echium vulgare*, *Epilobium palustre*, *Equisetum arvense*, *Euphorbia cyparissias*, *E. virgata*, *Galium verum*, *Geranium pusillum*, *Lamium amplexicaule*, *Lithospermum arvense*, *Lolium perenne*, *Lotus corniculatus*, *Mentha arvensis*, *Odontites verna*, *Phleum pratense*, *Plantago lanceolata*, *P. major*, *Ranunculus bulbosus*, *Rhinanthus serotinus*, *Rubus caesius*, *Rumex crispus*, *Senecio jacobaea*, *Sherardia arvensis*, *Silene vulgaris*, *Tragopogon pratensis*, *Trifolium pratense*, *Triticum aestivum*, *Veronica hederifolia*, *Vicia cracca*. Species included in constancy classes in cereal crops: *Anthemis arvensis*, *Erysimum cheiranthoides*, *Fumaria vaillantii*, *Galeopsis bifida*, *Lamium purpureum*, *Oxalis fontana*, *Pisum sativum*, *Potentilla anserina*, *Setaria pumila*, *S. virdis*, *Stachys annua*, *Thlaspi perfoliatum*, *Trifolium arvense*, *T. hybridum*, *Veronica agrestis*,*V. arvensis*, *Vicia dasycarpa*, *V. sativa*, *V. villosa*.

Tab. 2 Number of weed species found on rendzina soils in the Zamość region, according to their constancy classes.

Constancy class	Number of species			
	Fallow fields	%	Cereal crops	%
I	57	51	49	56
II	27	24	15	17
III	13	12	12	13
IV	5	5	7	8
V	9	8	4	5
Total species	111	100	87	100

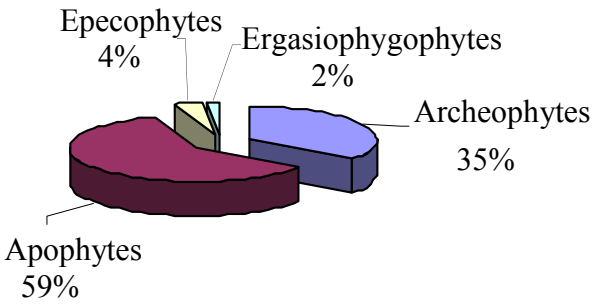

Fig. 1 Percentages of historical-geographical groups in the segetal flora found in abandoned fields on rendzina soils in the Zamość region.

of apophytes. Waterside and wetland apophytes comprise 7 species – 11%, forest and thicket apophytes – 9 species, i.e. 14%. The lowest number was recorded for apophytes of dunes, outwash plains and sandy grasslands, since it was only 3 taxa – 5% (Fig. 2).

Within the study area, common apophytes include the following: *Taraxacum officinale*, *Melilotus officinalis*, *Elymus repens*, *Campanula rapunculoides*, *Medicago lupulina*, *Cichorium intybus*, *Convolvulus arvensis*, *Sonchus arvensis*, and *Cirsium arvense*. Anthropophytes were also a heterogeneous group in terms of naturalization. The oldest ones, archeophytes (39 species), were dominant among them and they accounted for 35% of the total flora (Fig. 1). Among archeophytes, *Daucus carota* created abundant populations. The number of kenophytes (plants introduced at the turn of the 15th and 16th centuries), represented by epecophytes, was 4 species (Fig. 1). Ergasiophygophytes, presently cultivated plants that have escaped into the wild, among others *Avena sativa* and *Triticum aestivum*, had a small proportion in the flora of the study area (Fig. 1).

Weed infestation in cereal crops on rendzina soils

Segetal communities of high species diversity are found in cereal crops grown on rendzina soils. Eighty weed species were found in 12 relevés. The following species were dominant contributors to weed infestation in cereal crops

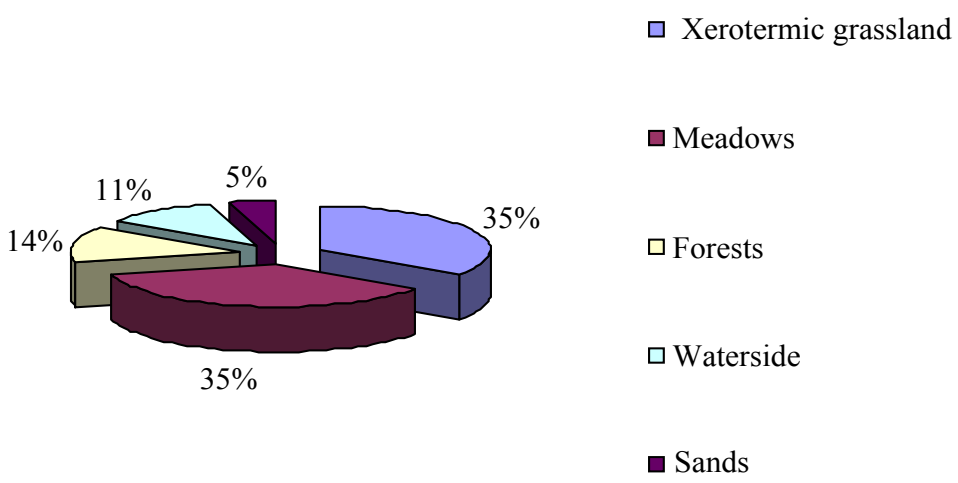

Fig. 2 Origin of apophytes in the segetal flora found in abandoned fields on rendzina soils in the Zamość region.

grown on rendzina soils: *Papaver rhoeas*, *Consolida regalis*, *Convolvulus arvensis*, *Galium aparine*, *Lathyrus tuberosus*, *Sinapis arvensis*, *Anagallis arvensis*, *Melandrium noctiflorum*, *Veronica persica*, and *Chenopodium album* (Tab. 1).

The segetal flora in cereal crops belongs to 29 botanical families. In terms of the number of species, the richest families are as follows: Asteraceae, Fabaceaee, Poaceae. The species-richest genera are the following: Vicia – 5 species, Veronica – 5 species and Sonchus – 3 species.

Apophytes are dominant in cereals; they are represented by 32 species, which accounts for 40% of the total recorded flora (Fig. 3). Meadow species (9–28%), followed by xerothermic grassland species (8–25%), predominate among various groups of apophytes. Forest and thicket apophytes comprise 8 species – 25%, waterside and wetland apophytes – 5 species, i.e., 16% (Fig. 4). The lowest number was recorded for apophytes of dunes, outwash plains and sandy grasslands, since it was only 2 taxa.

Within the study area, common apophytes include the following: *Campanula rapunculoides*, *Stellaria media*, *Polygonum aviculare*, *Chenopodium album*, and *Taraxacum officinale*. Anthropophytes were also a heterogeneous group in terms of naturalization. The oldest ones, archeophytes (43 species), were dominant among them and they accounted for 54% of the total flora (Tab. 1). Among archeophytes, the following were found in greatest numbers: *Papaver rhoeas*, *Consolida regalis*, *Avena fatua*, *Lathyrus tuberosus*, *Sinapis arvensis*, and *Melandrium noctiflorum*. The number of kenophytes (plants introduced at the turn of the 15th and 16th centuries), represented by epecophytes, was 4 species – 5% (Tab. 1). Ergasiophygophytes, presently cultivated plants that have escaped into the wild, among others *Pisum sativum*, had a small proportion in the flora of the study area.

Discussion

The floristic composition and the degree of weed infestation in crop fields depend on a multitude of natural and artificial habitat factors. Soil is the most important natural factor. Its mechanical composition, pH, humus and nutrient content as well as moisture content largely determine the species composition of segetal communities [24]. Rendzina soils are generally characterized by greater species richness of segetal weeds than other types of soil.

In the segetal flora on rendzina soils in the study area, 130 vascular plant species (excluding basic crop plants) were found in abandoned fields and cereal crops and they

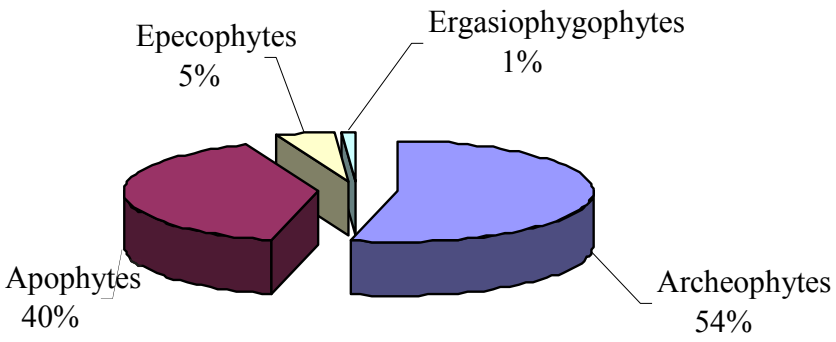

Fig. 3 Percentages of historical-geographical groups in the segetal flora found in cereal crops on rendzina soils in the Zamość region.

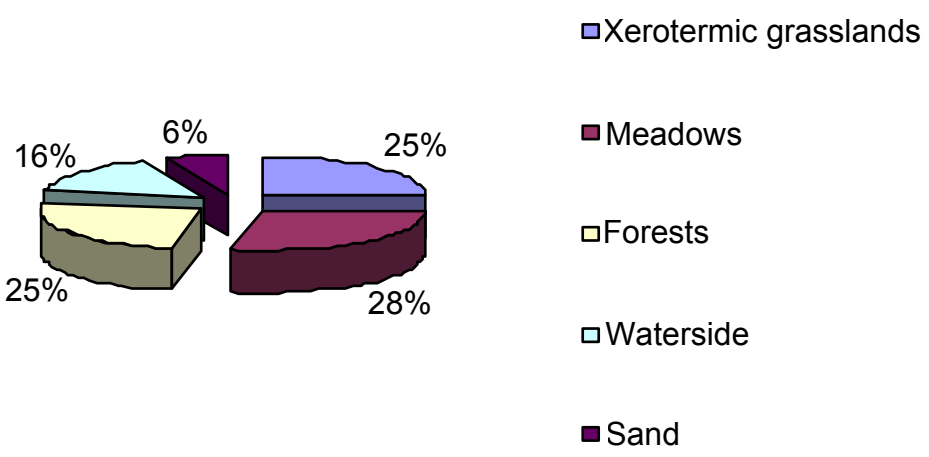

Fig. 4 Origin of apophytes in the segetal flora found in cereal crops on rendzina soils in the Zamość region.

represented different ecological groups, life forms and origin. Thus, this is quite a large number of species given that the study covered a small area. A similar state of segetal flora has been observed in other parts of our country, among others in Żuławy Wiślane – 176 species [25], and Beskid Wyspowy (Island Beskids) – 173 species [26]. Within the buffer zone of the Roztocze National Park, 233 weed species were found [27].

The segetal flora in abandoned fields and cereal crop fields belongs to 30 botanical families. In terms of the number of species, the richest families are as follows: Asteraceae, Fabaceae, Poaceae, Lamiaceae, Scrophulariaceae, and Brassicaceae. The species-richest genera are the following: *Vicia* – 6, *Euphorbia* – 5, *Veronica* – 5, *Trifolium* – 4, *Sonchus* – 3, and *Centaurea* – 3.

Based on the present study conducted using the Braun-Blanquet method, the species diversity of the segetal flora in abandoned fields and adjacent cereal crop fields can be compared. The communities in abandoned fields are characterized by higher richness. A total of 111 weed species were found in these fields, while in cereal crops – 80 weed species. Weeds of the highest constancy classes and cover indices determine the characteristics of the agrophytocenoses studied. Twenty four species classified in constancy classes V and IV with a high cover index had a major contribution to weed infestation. More species occurred in abandoned fields – 14 species, whereas in cereals 10 species were found.

The higher number of species included in the lowest constancy classes is evidence of the low stability of the segetal weed communities and their ongoing dynamics [20].

Species of native origin, apophytes that migrate to crop fields from other natural or semi-natural plant communities, are predominant in the segetal flora of the study area, like in other regions of Poland [25,28–32].

A total of 71 species are found in abandoned fields, which accounts for 55% of the total recorded flora. 32 species occur in abandoned fields and 66 species in cereal crops. Meadow species (26 species: 9 – abandoned fields, 24 – cereals), followed by xerothermic grassland species (23 species: 8 – abandoned fields, 23 – cereals), are predominant among various groups of apophytes. Forest and thicket apophytes include 11 species (8 – abandoned fields, 9 – cereals), whereas waterside and wetland apophytes comprise 7 species (5 – abandoned fields, 7 – cereals). The lowest number was recorded for apophytes of dunes, outwash plains and sandy grasslands, since it was only 4 taxa. Within the study area, common apophytes include the following: *Taraxacum officinale*, *Daucus carota*, *Melilotus officinalis*.

The oldest species of natural origin are archeophytes; 50 archeophytes are found within the study area, which accounts for 38% of the total recorded flora. The following species occurred in greatest numbers: *Sinapis arvensis*, *Melandrium noctiflorum*. The number of plants introduced at the turn of the 15th and 16th centuries, represented as epecophytes, was 6 species – 5% of the total flora. Ergasiophygophytes, presently cultivated plants that have escaped into the wild, among others *Avena sativa*, *Triticum aestivum*, and *Pisum sativum*, had a small proportion in the flora of the study area, only 2% of the recorded flora.

Similar proportions of particular weed groups were also observed within the area of the Skierbieszów Landscape Park [24].

When we compare weed infestation in abandoned fields and adjacent crop fields, the most common and most frequent species is *Papaver rhoeas* which belongs to the family Papaveraceae. It reached the highest degree of constancy (class V) both in abandoned fields and in cereals, while its cover index was 1180.0 in abandoned fields and 440.8 in cereals. It has also found optimal conditions for growth on rendzina soils within the buffer zone of the Roztocze National Park [20].

Calciphilous species, such as *Muscari comosum*, were found both in cereal crops and in abandoned fields. Many of these species were classified as rare taxa in our segetal flora [33]. These species reached much higher degrees of constancy in abandoned fields than in adjacent crop fields.

Conclusions

A total of 130 weed species belonging to 30 botanical families were found on rendzina soils in the Zamość region.

The species from Asteraceae, Fabaceae, Poaceae, Lamiaceae, Scrophulariaceae, and Brassicaceae were represented most frequently.

In the segetal flora, apophytes (55% of the total flora) predominated, with the highest number of meadow and xerothermic grassland species among them. Archeophytes (38%) predominate in the group of anthropophytes.

The species characterized by the highest constancy classes and reaching the highest cover indices posed the greatest threat to crops in the study area.

The following weeds are most frequently found in abandoned fields: *Consolida regalis*, *Cichorium intybus*, *Sinapis arvensis*, and *Convolvulus arvensis*, while *Papaver rhoeas* was the greatest threat to cereal crops.

Acknowledgments
This work was financially supported by the Department of Plant Biology, Faculty of Agricultural Sciences, University of Life Sciences in Lublin.

Authors' contributions
The following declarations about authors' contributions to the research have been made: study idea and design: TGW, MZS, BSB; acquisition of data: TGW, MZS; analysis and interpretation of data: TGW; drafting of manuscript: TGW, MZS, BSB.

Competing interests
No competing interests have been declared.

References
1. Filipiak K, Krasowicz S. Odłogowanie gruntów w Polsce. Bibl Fragm Agron. 2005;9:55–56.
2. GUS. Rocznik Statystyczny Województw 2003. Warszawa: Główny Urząd Statystyczny; 2003.
3. Wojciechowski W, Parylak D, Zawieja J. Oddziaływanie następstwa roślin i odłogowania na zapas nasion chwastów w glebie. Zesz Nauk UP Wroc Rol. 2008;92:59–66.
4. Hochół T, Łabza T, Stupnicka-Rodzynkiewicz E. Zachwaszczenie wieloletnich odłogów w porównaniu do stanu na polach uprawnych. Bibl Fragm Agron. 1998;5:115–123.
5. Rola J. Ekologiczno-gospodarcze skutki ugorów i odłogów w Polsce. Zesz Probl Postępów Nauk Roln. 1995;418:37–44.
6. Malicki L, Kurus J, Pałys E, Podstawka-Chmielewska E. Fitocenoza odłogu na glebie lekkiej i ciężkiej, jako element krajobrazu rolniczego. Fragm Agron. 2002;1(73):32–39.
7. Marks M, Nowicki J, Szwejowski Z. Odłogi ugory w Polsce. Cz. I. Przyczyny odłogowania i zjawiska towarzyszące. Fragm Agron. 2000;1(65):6–19.
8. Rola J, Rola H. Problem odłogów na gruntach porolnych i perspektywy ich racjonalnego zagospodarowania. Pamięt Puł. 2000;120:361–366.
9. Kutyna I. Stałość fitosocjologiczna i współczynnik pokrycia gatunków w zbiorowiskach roślinnych na odłogach jednorocznych i trzyletnich. Zesz Nauk Akad Rol Szczec Rol. 1997;68:163–177.
10. Trąba C, Ziemińska M. Flora odłogujących pól uprawnych w otulinie Roztoczańskiego Parku Narodowego. In: XVI Krajowa konferencja "Zmiany w zachwaszczeniu pól wywołane trudną sytuacją ekonomiczną rolnictwa"; 1992 Jun 22–23; Szczecin, Poland. Szczecin: Wydawnictwo AR Szczecin; 1993. p. 44–57.
11. Majda J, Buczek J, Trąba C. Plenność niektórych gatunków chwastów owocujących na odłogu. Ann Univ Mariae Curie-Skłodowska E Agric. 2007;62(2):48–55.
12. Majda J, Trąba C, Wolański P. Bank diaspor w glebie lessowej na polu uprawnym i wieloletnim odłogu na tle składu florystycznego fitocenoz. Fragm Agron. 2006;23(4):119–129.
13. Stupnicka-Rodzynkiewicz E, Hochół T, Łabza T. Wpływ jednorocznego okresu wyłączenia pola z uprawy na zapas nasion chwastów glebie i zachwaszczenia łanu. Bibl Fragm Agron. 1998;5:161–171.
14. Rola J, Rola H. Ograniczenie zarastania chwastami segetalnymi i ruderalnymi ugorów oraz odłogów. Bibl Fragm Agron. 1998;5:145–160.
15. Podstawka-Chmielewska E, Pałys E, Kurus J. Zmiany fitocenozy w czasie wieloletniego odłogowania gruntu ornego na rędzinie. Ann Univ Mariae Curie-Skłodowska E Agric. 2004;59(4):1807–1814.
16. Sekutowski T, Rola H. Wpływ systemów uprawy na bank nasion chwastów w glebie. Post Ochr Roślin. 2006;46(2):116–119.
17. Kutyna I, Leśnik T. Rośliny i zioła w agrocenozach Niziny Szczecińskiej. Pamięt Puł. 2003;134:141–147.
18. Łabza T, Hochół T, Stupnicka-Rodzynkiewicz E, Jaros J. Zachwaszczenie odłogów i pól sąsiadujących z uprawami zbóż na przykładzie wybranych siedlisk, cz. I: ważniejsze wskaźniki zachwaszczenia. Bibl Fragm Agron. 1997;3:267–270.
19. Marks M, Nowicki J. Aktualne problemy gospodarowania ziemią rolniczą w Polsce. Cz. 1. Przyczyny odłogowania gruntów i możliwości ich rolniczego zagospodarowania. Fragm Agron. 2002;1:58–67.
20. Ziemińska-Smyk M. Zachwaszczenie pól wyłączonych czasowo z użytkowania rolniczego w otulinie Roztoczańskiego Parku Narodowego. In: Conference proceedings: "Problemy ochrony i użytkowania obszarów wiejskich o dużych walorach przyrodniczych"; 2000 Oct 20–21; Janów Lubelski, Poland. Lublin: Wydawnictwo UMCS; 2000. p. 274–277.
21. Dzwonko Z. Przewodnik do badań fitosocjologicznych. Poznań: Sorus; 2007.
22. Mirek Z, Piękoś-Mirkowa H, Zając A, Zając M. Flowering plants and pteridophytes of Poland. A checklist. Kraków: W. Szafer Institute of Botany, Polish Academy of Sciences; 2002. (Biodiversity of Poland; vol 1).
23. Uziak S, Turski R. Środowisko przyrodnicze Lubelszczyzny. Lublin: Lubelskie Towarzystwo Naukowe; 2008.
24. Ziemińska-Smyk M. Zbiorowiska chwastów segetalnych w zbożach ozimych i jarych na glebach lessowych na terenie Skierbieszowskiego Parku Krajobrazowego. Ann Univ Mariae Curie-Skłodowska E Agric. 2008;63(3):98–108.
25. Hołdyński C. Flora segetalna, zróżnicowanie florystyczno-ekologiczne i przemiany szaty roślinnej pól uprawnych w aktualnych warunkach agroekologicznych Żuław Wiślanych. Acta Acad Agric Tech Olst Agric. 1991;51:3–50.
26. Hochół T. Zbiorowiska chwastów segetalnych w dolinie rzeki Łososiny w Beskidzie Wyspowym. Część II. Zachwaszczenie upraw zbożowych. Zesz Nauk Akad Rol Krak Rol. 1990;29:77–92.
27. Ziemińska-Smyk M. Flora segetalna w otulinie Roztoczańskiego Parku Narodowego. Acta Agrobot. 2006;59(2):275–289. http://dx.doi.org/10.5586/aa.2006.083
28. Korniak T. Flora segetalna północno-wschodniej Polski, jej przestrzenne zróżnicowanie i współczesne przemiany. Acta Acad Agric Tech Olst Agric. 1992;53:1–76.
29. Kutyna I. Stałość występowania i średnie pokrycie chwastów z zbiorowiskach pól odłogujących i upraw jęczmienia jarego na glebach wytworzonych z glin w okolicy Szczecina. In: Conference proceedings: "Przyczyny i źródła zachwaszczenia pól uprawnych"; 1994 Jun 28–29; Olsztyn-Bęsia, Poland. Olsztyn: Akademia Rolniczo-Techniczna w Olsztynie; 1994. p. 125–130.
30. Łabza T. Ekologiczne i rolnicze aspekty zachwaszczenia upraw zbożowych i okopowych w województwie krakowskim. Zesz Nauk AR w Krakowie Rozp Nauk. 1994;194:1–122.
31. Skrzyczyńska J, Rzymowska Z. Flora segetalna Podlaskiego Przełomu Bugu. Acta Agrobot. 2001;54(1):115–135. http://dx.doi.org/10.5586/aa.2001.011
32. Szotkowski P. Chwasty upraw okopowych i zbóż ozimych w

południowo-wschodnim obszarze Śląska Opolskiego. Warszawa: Wydawnictwo Naukowe PWN; 1981.

33. Trąba C, Ziemińska M. Stan gatunków chwastów segetalnych uważanych za zagrożone w otulinie Roztoczańskiego Parku Krajobrazowego. Acta Univ Lodz Folia Bot. 1998;13:265–272.

Flora odłogów i sąsiadujących z nimi pól uprawnych na glebach rędzinowych Zamojszczyzny

Streszczenie

We florze segetalnej gleb rędzinowych Zamojszczyzny zanotowano łącznie 130 gatunków chwastów, należących do 30 rodzin botanicznych. Do najczęściej reprezentowanych rodzin należały: Asteraceae, Fabaceae, Poaceae, Lamiaceae, Scrophulariaceae i Brassicaceae. We florze segetalnej przeważają apofity (55% ogółu flory), wśród których najwięcej jest gatunków łąkowych i muraw kserotermicznych. W grupie antropofitów dominują archeofity (38%). Największe zagrożenie dla upraw badanego terenu stanowiły gatunki charakteryzujące się najwyższymi stopniami stałości i osiągające najwyższe współczynniki pokrycia. Najczęściej występującymi chwastami na odłogach są *Taraxacum officinale*, *Daucus carota*, *Melilotus officinalis*, *Elymus repens*, *Campanula rapunculoides*, *Papaver rhoeas*, *Consolida regalis*, *Medicago lupulina*, *Matricaria maritima* subsp. *inodora*. Uprawom zbóż na rędzinach najbardziej zagrażały: *Papaver rhoeas*, *Consolida regalis*, *Convolvulus arvensis*, *Galium aparine*. Zarówno w uprawach zbóż jak i na odłogach najczęściej występuje *Papaver rhoeas*.