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SYNANTHROPIC ORCHARD FLORA IN WEST MAZOVIA – CENTRAL POLAND

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A B S T R A C T

Research on synanthropic flora was conducted in the orchards of central Poland (near Skierniewice, Łowicz and Grójec). In the 2007-2010 time period, 390 phytosociological releves were taken, which included herbicide fallow under trees, swarm of inter-rows, tillage places, trodden and rutty places, roadsides, boundary stripes and drainage ditches. In the examined orchards the occurrence of 186 species belonging to 39 botanical families was noted. The most numerously represented were: *Asteraceae* (21%), *Poaceae* (15%), *Brassicacea* (8%) and *Fabaceae* (7%). In the examined orchards, 60% of the found species occurred occasionally or rarely. Those species which were found at the 15% level were: *Equisetum arvense*, *Polygonum aviculare*, *Chenopodium album*, *Amaranthus retroflexus*, *Stellaria media*, *Capsella bursa-pastoris*, *Convolvulus arvensis*, *Viola arvensis*, *Epilobium adenocaulon*, *Conyza canadensis*, *Taraxacum officinale*, *Poa annua*, and *Echinochloa crus-galli*. All of these species which occurred at the 15% level were most frequently noted in the herbicide fallow and were recognised as the most significant orchard weeds. The most numerous group in the examined orchards was made up of the therophytes (50%), which predominated over hemicryptophytes (31%) and geophytes (10%). Apophytes – native species (59%) predominated over archeophytes (33%) and kenophytes (8%). Within the vascular flora of the examined orchards, those which were predominant were the segetal species (26%), ruderal species (21%) and meadow species (19%).

Key words: Orchard, synanthropic plants, weeds

INTRODUCTION

The work aimed to identify the most significant and expansive weeds as well as to assess the diversity of synanthropic flora of commercial orchards in the central part of Poland, taking human activity into account. Results of floristic research enable better identification of risks caused by weeds as well as proper modification of weed control programmes. In Poland, there are few publications concerning those issues. The most inclusive description of the synanthropic flora of commercial orchards is presented by Wróbel (1999). Change dynamics in weed infestation influenced by the use of herbicides over several years, are described by Lipecki (2004). Weed infestation in an organic orchard, where the soil was mulched with compost and treated mechanically, was the subject of research conducted in central Poland (Mika, 2004). In an orchard with Integrated Pest Management (IPM), weed infestation, including species composition, is dependent on the method of weed control and meteorological factors (Markuszewski and Kopytowski, 2008).

Authors evaluating the species composition of orchard flora, both in Poland and abroad, pay special attention to the fundamental role played by human activity, including the use of herbicides and other means of protection against weeds (Conticello and Gandullo, 1991; Jung et al., 1997; Novo et al., 2000; Lisek, 2001; Harrington et. al., 2002; Rifai et al., 2002; Mashaly and Awad, 2003; Tasseva, 2005; Ustuner and Ustuner, 2011). Occurrence and number of plants constituting synanthropic flora, together with weeds − most important from the economical point of view − depend to a substantial degree, on their biology and environmental conditions (Tymrakiewicz, 1976; Mowszowicz, 1984).

MATERIAL AND METHODS

Field examinations were conducted in the West Mazovian Region of central Poland near Skierniewice (Skierniewice – Pomological Orchard, Dąbrowice, Julków, Strobów), Łowicz (Ostrowiec, Maurzyce) and Grójec (Belsk Duży, Lewiczyn, Błędów, Wólka Łęczeszycka, Goliany). The Braun-Blanquet method was used to analyse 390 phytosociological releves, taken in the years 2007-2010. The orchards were most often located on a flat area and podsolic soil graded Class IV, rarely III or V. The soil was slightly acidic (pH 6.0-6.7). Soil from three selected sites (Dąbrowice, Julków, Ostrowiec) was characterised by the following mechanical composition: sand: 69-84%, silt: 12-30%, clay: 1-4%, and soil which contained 1.5-1.6% of organic matter. The research was conducted in large commercial orchards belonging to 40 specialised horticultural farms cultivating apples, pears, plums, sour cherries, sweet cherries, and peaches. The research was also conducted in 2 experimental orchards. The soil of the newly established orchards was cultivated mechanically, with limited use of herbicides in the row of trees. Starting with the second

or third year the inter-rows were grassed with long-lasting and frequently mowed meadow grasses. In the tree rows, post-emergence herbicides were applied 2-4 times a year (glyphosate, MCPA and glufosinate were used most often). The following features characterised 80% of the assessed orchard: 3-15 years old, herbicide fallow under trees, and grassed inter-rows. Species composition of flora was evaluated from April to September. Names of taxa were given after Mirek et al. (2002) as amended. Taxa were analysed according to the following criteria:

Frequency of occurrence in the investigated area:

1 – occasionally (≤ 5% of sites); 2 – rarely (5.1-10% of sites); 3 – average (10.1-30% of sites); 4 – often (30.1 – 50% of sites); 5 – very often (> 50.1% of sites).

Life form according to Raunkiaer (Rutkowski, 2007):

- perennials: M – megaphanerophyte – tree; N – nanophanerophyte – shrub; Ch – herbaceous chamaephyte; G – geophyte; H – hemicryptophyte;
- short-lived: T1 – annual therophyte; T2 – biennial therophyte.

Geographical-historical classification according to Kornaś (1981), Zając and Zając (1992):

- Ap. – apophyte; Arch. – archeophyte; Ken. – kenophyte; Erg. – ergasiophyte.

Socio-ecological groups according Ellenberg et al. (1992):

- DW – deciduous woodland species; CD – coniferous woodland species; SE – shrub edges species; M – meadow species; SS – sandy sward species; XS – xerothermic sward species; RD – ruderal species; SG – segetal species; SW – swamp species; N – species of under classification.

Sites of occurrence in investigated orchards:

- TP – tillage places; HF – herbicide fallow under trees; SI – swarm of inter-rows; TR – trodden and rutty places; RS – roadsides: BS – boundary stripes; D – drainage ditches.

RESULTS

Frequency of occurrence of vascular plants. From among 186 vascular plants, 112 species (60%) occurred occasionally or rarely, including *Consolida regalis*, *Malva sylvestris*, *Lythrum salicilaria*, *Anagalis arvensis*, *Stachys palustris* (Tab. 1). Plants of 27 species (15% of the total number), eg. *Equisetum arvense*, *Polygonum aviculare*, *Chenopodium album*, *Amaranthus retroflexus*, *Stellaria media*, *Capsella bursa-pastoris*, *Convolvulus arvensis*, *Viola arvensis*, *Epilobium adenocaulon*, *Conyza canadensis*, *Taraxacum officinale*, *Poa annua*, *Echinochloa crus-galli*, occurred frequently of very frequently.

Species affiliation with botanical families. Plants growing in the

Table 1. Synanthropic flora of commercial orchards in West Mazovia – central Poland, 2007-2010

Families and species	Frequency	Life form	Geographical - historical class.	Socio-ecological class.	Sites
Equisetaceae					
Equisetum arvense L.	4	G	Ap.	SG	HF, BS
Juglandaceae					
Juglans regia L.	1	M	Erg.	-	HF, BS
Cannabaceae					
Humulus lupulus L.	1	H	Ap.	DW, SE	BS, HF
Urticaceae					
Urtica dioica L.	3	H	Ap.	RD, SE	HF, BS
Urtica urens L.	3	T1	Arch.	SG	HF, TP
Polygonaceae					
Polygonum amphibium L. var. *terrestre*	1	G	Ap.	SW	BS, HF
Polygonum aviculare L.	4	T1	Ap.	RD	HF, TP, RS, TR
Polygonum persicaria L.	3	T1	Ap.	SG	TP, HF, BS
Polygonum lapathifolium L. ssp. *lapathifolium*	1	T1	Ap.	SW	BS, D
Fallopia convolvulus (L.) A. Löve	3	T1	Arch.	SG	HF, TP
Rumex acetosella L.	3	G	Ap.	SS, CW	HF, SI, BS
Rumex acetosa L.	2	H	Ap.	M	BS, SI, RS, HF
Rumex crispus L.	2	H	Ap.	RD	SI, HF, BS, RS
Rumex obtusifolius L.	1	H	Ap.	RD	SI, HF, BS
Chenopodiaceae					
Chenopodium album L.	4	T1	Ap.	SG	HF, TP
Chenopodium polyspermum L.	1	T1	Ap.	SG	TP, HF
Atriplex patula L.	2	T1	Ap.	SG	HF, TP
Amaranthaceae					
Amaranthus retroflexus L.	4	T1	Ken.	SG	HF, TP
Caryophyllaceae					
Arenaria serpyllifolia L.	3	T1	Ap.	SS	HF, SI, RS
Stellaria media (L.) Vill.	5	T1	Ap.	SG	HF, TP
Cerastium arvense L.	3	H	Ap.	M	HF, TP, SI
Cerastium holosteoides Fr. em. Hyl.	2	T2, H	Ap.	M	HF, TP, SI
Spergula arvensis L.	1	T1	Arch.	SG	TP, HF
Spergularia rubra (L.) J. Pres et C. Presl.	2	T1-H	Arch.	SG	TP, HF
Melandrium album (Mill.) Garcke (*Silene alba* (Mill.) E.H.L Krause)	2	H	Ap.	RD	RS, BS, HF, SI
Ranunculaceae					
Consolida regalis Gray	1	T1	Arch.	SG	TP, HF
Myosurus minimus L.	3	T1	Ap.	SW	HF
Ranunculus repens L.	3	H	Ap.	M	HF, BS, SI, D
Papaveraceae					
Papaver argemone L.	1	T1	Arch.	SG	TP, HF
Papaver dubium L.	1	T1	Arch.	SG	TP, HF, RS
Papaver rhoeas L.	2	T1	Arch.	SG	TP, HF
Chelidonium majus L.	2	H	Ap.	SE	BS

Fumariaceae					
Fumaria officinalis L.	1	T1	Arch.	SG	HF, TP
Brassicaceae					
Rorippa sylvestris (L.) Besser	3	H	Ap.	RD	HF, RS, BS
Barbarea vulgaris R. Br.	1	T2-H	Ap.	M, RD	RS, D
Sisymbrium officinale (L.) Scop.	1	T1	Arch.	RD	RS, HF
Sisymbrium loeselii L.	1	T1-T2	Ken.	RD	RS, HF
Descurainia sophia (L.) Webb ex Prantl	1	T1-T2	Arch.	RD	RS, BS, HF
Erysimum cheiranthoides L.	1	T1-T2	Ap.	SG	RS, BS, HF
Arabidopsis thaliana (L.) Heynh.	1	T1	Arch.	SG	HF, RS, BS
Alliaria petiolata (M. Bieb.) Cavara et Grande	1	T2	Arch.	SE	BS
Sinapis arvensis L.	1	T1	Arch.	SG	TP, HF
Armoracia rusticana G., M. et Sch.	2	H	Arch.	RD	RS, BS, HF
Erophila verna (L.) Chevall.	4	T1	Ap.	SS	HF
Thlaspi arvense L.	2	T1	Arch.	SG	TP, HF
Teesdalea nudicaulis (L.) R. Br.	2	T1	Arch.	SS, CW	HF
Capsella bursa-pastoris (L.) Med.	5	T1	Arch.	SG, RD	HF, TP
Raphanus raphanistrum L.	3	T1	Arch.	SG	TP, HF
Crassulaceae					
Sedum acre L.	1	H	Ap.	SS	RS
Rosaceae					
Rosa canina L.	1	N	Ap.	SE	BS, D
Rubus caesius L.	1	Ch.	Ap.	DW, SE	BS, RS
Potentilla anserina L.	3	H	Ap.	M	HF, BS, SI
Potentilla reptans L.	3	H	Ap.	M	HF, BS, SI
Geum urbanum L.	1	H	Ap.	SE, DW	BS
Fabaceae					
Vicia angustifolia Scop.	1	T1	Arch.	M	TP, HF
Vicia hirsuta (L.) S.F. Gray	2	T1	Arch.	SG	TP, HF
Vicia tetrasperma (L.) Schreb.	1	T1	Arch.	SG	TP, HF
Vicia villosa Roth.	3	T1	Arch.	SG	TP, HF, BS
Vicia cracca L.	2	G	Ap.	M	BS, HF
Lathyrus pratensis L.	2	H	Ap.	M	RS, SI
Melilotus alba Medik.	1	T2	Ap.	RD	RS, BS, D
Medicago lupulina L.	3	T1-T2	Ap.	XS, M	RS, SI
Trifolium arvense L.	1	T1-T2	Ap.	SS	SI, RS
Trifolium dubium Sibth.	1	T1	Ap.	M	SI, RS
Trifolium repens L.	4	H	Ap.	M	SI, HF
Trifolium hybridum L.	1	H	Ap.	M	SI
Trifolium pratense L.	2	H	Ap.	M	SI, BS
Geraniaceae					
Geranium pusillum Burm. F. ex L.	4	T1	Arch.	SG	HF, TP, SI
Geranium molle L.	1	T1	Arch.	RD	SI
Erodium cicutarium (L.) L'Hér.	2	T1	Ap.	XS, SG	RS, HF, TP, SI
Sapindaceae					
Acer negundo L.	1	M	Ken.	DW	BS, HF
Balsaminaceae					
Impatiens parviflora DC.	1	T1	Ken.	DW, SE	BS
Euphorbiaceae					
Euphorbia helioscopia L.	2	T1	Arch.	SG	TP, HF
Euphorbia peplus L.	1	T1	Arch.	SG	TP, HF
Malvaceae					
Malva neglecta L.	3	T2-H	Arch.	RD	HF, BS
Malva pusilla Sm.	1	T1-2, H	Arch.	RD	RS, BS, HF
Malva sylvestris L.	1	T2-H	Arch.	RD	RS, BS, HF

Clusiaceae (Hypericaceae)					
Hypericum perforatum L.	2	H	Ap.	DW	BS, HF
Violaceae					
Viola arvensis Murray	4	T1	Arch.	SG	HF, TP
Viola tricolor L.	1	T1	Ap.	N	BS, HF, TP
Lythraceae					
Lythrum salicilaria L.	1	H	Ap.	M, SW	BS, D
Onagraceae					
Epilobium hirsutum L.	1	H	Ap.	M, RD	BS, D, HF
Epilobium adenocaulon Hausskn.	5	H	Ken.	RD, SW	HF, BS
Epilobium adnatum Griseb.	2	H	Ap.	M, SW	BS, D, HF
Epilobium montanum L.	2	H	Ap.	DW, SE	HF, BS
Epilobium roseum Schreb.	1	H	Ap.	SW, SE	HF, BS, D
Chamaenerion angustifolium (L.) Scop.	1	H	Ap.	SE	BS
Apiaceae					
Aegopodium podagraria L.	2	H	Ap.	DW	BS, HF, SI
Aethusa cynapium L.	1	T1	Arch.	RD	BS
Chaerophyllum temulum L.	2	T2	Ap.	DW	BS
Heracleum sphondylium L.	2	T2-H	Ap.	M	HF, BS
Daucus carota L.	2	T2	Ap.	M	BS, HF
Primulaceae					
Anagalis arvensis L.	1	T1	Arch.	SG	TP, HF
Rubiaceae					
Galium aparine L.	4	T1	Ap.	SE	HF, BS, TP
Gallium album Mill.	2	H	Ap.	M	BS, D
Adoxaceae					
Sambucus nigra L.	1	N	Ap.	SE	BS
Convolvulaceae					
Convolvulus arvensis L.	4	G	Ap.	RD	HF, BS, RS
Calystegia sepium (L.) R. Br.	1	G	Ap.	SE	BS
Boraginaceae					
Lithospermum arvense L.	1	T1	Arch.	SS, RD	RS, HF
Anchusa arvensis (L.) M. Bieb.	1	T1	Arch.	SG, SS	RS, BS
Echium vulgare L.	1	T2	Ap.	RD	RS
Myosostis stricta Link ex Roem. et Schult.	2	T1	Arch.	SG	TP, HF, SI
Myosostis arvensis (L.) Hill	3	T1	Arch.	SG	HF, TP, D
Solanaceae					
Solanum nigrum L. em. Mill.	3	T1	Arch.	SG	HF, TP
Scrophulariaceae					
Linaria vulgaris Mill.	1	G	Ap.	SS	RS, BS
Veronica chamaedrys L.	3	H	Ap.	M	SI, BS, HF
Veronica arvensis L.	3	T1	Arch.	SG	TP, HF
Veronica persica Poir.	3	T1	Ken.	SG	HF, TP
Veronica hederifolia L.	1	T1	Arch.	SE	BS, HF
Lamiaceae					
Glechoma hederaceae L.	2	H	Ap.	SE	BS, HF, SI
Galeopsis tetrahit L.	2	T1	Ap.	DW,CW	TP, HF, BS
Lamium purpureum L.	4	T1	Arch.	SG	HF, TP
Lamium amplexicaule L.	3	T1	Arch.	SG	TP, HF
Stachys palustris L.	1	G	Ap.	SW	BS, D, HF
Ballota nigra L.	1	Ch, H	Arch.	RD	BS, RS
Mentha arvensis L.	1	G	Ap.	M, SW	BS, D, HF

Plantaginaceae					
Plantago major L.	4	H	Ap.	RD	SI, RS, TR, HF
Plantago lanceolata L.	4	H	Ap.	M	SI, HF
Asteraceae					
Solidago canadensis L.	3	G, H	Ken.	RD	BS, HF
Solidago gigantea Aiton	2	G	Ken.	RD	BS, HF
Conyza canadensis (L.) Cronq.	5	T1-T2	Ken.	RD	HF, TP, RS
Erigeron annuus (L.) Pers.	1	T2-H	Ken.	RD	BS, HF
Gnaphalium uliginosum L.	1	T1	Ap.	M, SW	TP, HF, D, SI
Bidens tripartita L.	1	T1	Ap.	M, SW	BS, HF
Galinsoga parviflora Cav.	3	T1	Ken.	SG	TP, HF
Galinsoga ciliata (Raf.) S.F. Blake	2	T1	Ken.	SG	TP, HF
Anthemis arvensis L.	2	T1	Arch.	SG	TP, HF
Achillea millefolium L.	3	G	Ap.	M	SI, RS, HF
Matricaria maritima L. ssp. *inodora* (L.) (*Matricaria perforata* Mérat)	3	T1-2, H	Arch.	SG	HF, TP, BS, RS
Chamomilla suaveolens (Pursh) Rydb. (*Matricaria discoidea* DC.)	4	T1	Ken.	RD	RS, TR, HF
Chamomilla recutita L. Rauschert	2	T1	Arch.	SG	RS, TP, HF
Tanacetum vulgare L.	2	H	Ap.	RD	RS, BS
Artemisia vulgaris L.	3	H	Ap.	RD	BS, HF
Tusillago farfara L.	1	G	Ap.	RD	RS, BS
Senecio vulgaris L.	4	T1	Arch.	SG	HF, TP
Senecio jacobaea L.	2	T1	Ap.	XS	RS, HF, BS
Arctium tomentosum Mill.	2	T2	Ap.	RD	RS, BS
Cirsium vulgare (Savi) Ten.	1	T2	Ap.	RD	BS, SI, HF
Cirsium arvense (L.) Scop.	3	G	Ap.	RD	HF, TP, BS
Centaurea jacea L.	1	H	Ap.	M	RS
Cichorium intybus L.	2	H	Arch.	RD	RS
Hypochoeris radicata L.	3	H	Ap.	SS, CW	SI, RS
Hypochoeris glabra L.	1	T1	Arch.	SS	SI, RS
Tragopogon pratensis L.	1	T2	Ap.	M	SI, RS
Leontodon autumnalis L.	3	H	Ap.	M, RD	SI, HF
Leontodon hispidus L.	2	H	Ap.	M	SI
Picris hieracioides L.	1	H	Ap.	RD	SI, RS
Sonchus oleraceus L.	3	T1	Arch.	SG	TP, HF, BS
Sonchus asper (L.) Hill	2	T1	Arch.	SG	BS, HF, TP
Sonchus arvensis L.	2	H	Ap.	SG	HF, BS, TP
Lactuca serriola L.	3	T2	Arch.	RD	HF, RS, BS
Taraxacum officinale F. H. Wigg.	5	H	Ap.	M	HF, SI
Lapsana communis L.	1	T1	Ap.	SE	BS, HF, SI
Crepis biennis L.	3	T2	Ap.	M	SI, HF
Crepis tectorum L.	3	T1-2	Ap.	SS	SI, RS
Crepis capillaris (L.) Wallr.	3	T1-2	Ap.	M	SI, RS
Hieracium pilosella L.	3	H	Arch.	SS, XS	SI, RS
Juncaceae					
Juncus conglomeratus L.	1	H	Arch.	M, SW	D, SI
Cyperaceae					
Carex hirta L.	1	G	Ap.	SW, RD	D, SI
Poaceae					
Festuca pratensis Huds.	3	H	Ap.	M	SI, BS
Festuca rubra L.	4	H	Ap.	M	SI, BS
Lolium perenne L.	5	H	Ap.	M, RD	SI, HF, BS
Lolium multiflorum Lam.	2	H	Ken.	RD	SI, BS
Poa compressa L.	2	H	Ap.	SS, XS	SI, BS
Poa annua L.	5	T1	Ap.	M, RD	HF, TP, RS, TR
Poa pratensis L.	4	H	Ap.	M	SI, BS
Poa angustifolia L.	3	H	Ap.	M	SI, BS
Poa trivialis L.	2	H	Ap.	M	SI, BS
Dactylis glomerata L.	3	H	Ap.	M	SI, BS
Apera spica-venti (L.) P. Beauv.	2	T1	Arch.	SG	TP
Bromus sterilis L.	2	T2	Arch.	SE	HF, BS

Bromus inermis Leyss.	3	G	Ap.	RD	HF, BS
Bromus hordeaceus L.	4	T2	Ap.	RD	HF, BS
Agropyron repens L.	4	G	Ap.	RD	HF, BS, TP
Hordeum murinum L.	3	T2	Arch.	RD	RS, BS
Holcus mollis L.	2	G	Ap.	SS	SI, BS
Agrostis capillaris L.	3	H	Ap.	SS, XS	SI, HF, BS
Agrostis gigantea Roth	2	G	Ap.	M	HF, BS
Calamagrostis epigejos (L.) Roth	1	G	Ap.	DW, CW	D, BS
Phleum pretense L.	2	H	Ap.	M	SI, BS
Alopecurus pratensis L.	3	H	Ap.	M	SI, BS
Alopecurus aequalis Sobol.	1	T1	Ap.	SW	SI, BS
Echinochloa crus-galli (L.) P. Beauv.	4	T1	Arch.	SG	HF, TP
Digitaria sanguinalis (L.) Scop.	3	T1	Arch.	SG	HF, TP
Setaria pumila (Poir.) Roem et Schult.	3	T1	Arch.	SG	HF, TP
Setaria viridis (L.) P. Beauv.	2	T1	Arch.	SG	HF, TP

Explanation

Frequency of occurrence in the investigated area:
1 – occasionally; 2 – rarely; 3 – average; 4 – often; 5 – very often (> 50.1% of sites).

Life form according to Raunkiaer:
- perennials: M – megaphanerophyte – tree; N – nanophanerophyte – shrub; Ch – herbaceous chamaephyte; G – geophyte; H – hemicryptophyte;
- short-lived: T1 – annual therophyte; T2 – biennial therophyte.

Geographical-historical classification:
Ap. – apophyte; Arch. – archeophyte; Ken. – kenophyte; Erg. – ergasiophyte.

Socio-ecological groups:
DW – deciduous woodland species; CD – coniferous woodland species; SE – shrub edges species; M – meadow species; SS – sandy sward species; XS – xerothermic sward species; RD – ruderal species; SG – segetal species; SW – swamp species; N – species of under classification.

Sites of occurrence in investigated orchards:
TP – tillage places; HF – herbicide fallow under trees; SI – swarm of inter-rows; TR – trodden and rutty places; RS – roadsides: BS – boundary stripes; D – drainage ditches.

examined orchards belonged to 39 botanical families. Most numerously represented were: *Asteraceae* – 39 species (21%), *Poaceae* – 27 species (15%), *Brassicacea* – 15 species (8%), *Fabaceae* – 13 species (7%).

Participation of Raunkiaer's life forms. Ninety-three species (50% of the total number of plants collected) were therophytes (T), i.e. short-lived forms, mostly annuals. Fifty-eight species (31%) were classified as hemicryptophytes (H), and 19 species (10%) as geophytes (G). Nine species (5%), among others, *Malva* sp., *Heracleum sphondylium*, *Erigeron annuus*, *Matricaria maritima* constituted both short lived forms and long lived forms. The rest of the long-lived species (perennials) were classified as megaphanerophyte – 2 species; nanophanerophyte – 2; chamaephyte/hemicryptophyte – 1; geophyte/hemicryptophyte – 1.

Geographical-historical classification. Flora of the evaluated orchards consisted mostly of apophytes (native plants), of which 110 species were collected (59%). There was also the noted occurrence of 61 species of archeophytes (33% of all species), 14 kenophytes (8%) and 1 ergasiophyte (*Juglans regia*). From the 14 kenophytes, 9 originated in America, 3 (*Sisymbrium loeselii*, *Veronica persica* and *Impatiens parviflora*) from Asia, 1 (*Chamomilla suaveolens*) in the north-western part of America and East Asia and 1 (*Lolium multiflorum*) in the Mediterranean region.

Socio-ecological classification. The predominant species in the flora of the examined orchards were typically segetal, and there were 49 (26%) of these segetal species. There was also a substantial share of typically ruderal species – 39 (21%), meadow species – 35 (19%), sandy and xerothermic sward species – 13 (7%) as well as shrub edges species – 10 (5%). Species typical of other socio-ecological groups were not numerous.

Preferences of site. Weed occurrence at the particular sites of the orchard was presented in Table 1. Number of species in the sites assessed was as following: herbicide fallow – 128, boundary stripes – 100, tillage places – 61, swarm of inter-rows – 58, roadsides – 52, drainage ditches – 17. Trodden and rutty places belonged to sites occupied by the most limited number of species – 4. Twenty species occurred on only one site, e.g. *Sedum acre* in roadsides. Other species occurred on at least two sites.

DISCUSSION

The number of species of synanthropic plants occurring in the orchards of Central Poland did not diverge substantially either from the number noted in the orchards near Szczecin (in the north-western part of Poland − 162 species) (Wróbel, 1999), or from the number noted in the orchards of the Nile Delta in Egypt – 169 species (Mashaly and Awad, 2003). Especially important from the practical point of view, is the occurrence of plants of large biomass under branches of trees: in the herbicide fallow stripes, as well as in the swarms of inter-rows, which are considered weeds in the growing season. The same weeds should be regarded as most significant both in the commercial, conventional orchards of the central part of Poland and in the orchards treated with herbicides of the north-western (Wróbel, 1999) and eastern (region of Lublin) parts of Poland (Lipecki, 2004). In this group, among others, are: *Equisetum arvense*, *Chenopodium album*, *Amaranthus retroflexus*, *Stellaria media*, *Capsella bursa-pastoris*, *Convolvulus arvensis*, *Epilobium adenocaulon*, *Taraxacum officinale*, *Conyza canadensis*, *Poa annua*, and *Echinochloa crus-galli*. In the flora of young organic orchards in Skierniewice (central part of Poland), those weeds which consist of 25 species, such as *Stellaria media*, *Capsella bursa-pastoris*, and *Geranium pusillum*, and are typical of

the regional orchards where herbicides are applied, did not occur (Mika, 2004). In the orchards with the IPM, located in the Warmia and Mazury Province (in the north-eastern part of Poland), predominant were *Senecio vulgaris* and *Stellaria media*, whereas *Chenopodium album*, *Urtica urens*, *Vicia tetrasperma*, *Capsella bursa-pastoris*, *Equisetum arvense*, *Echinochloa crus-galli*, *Polygonum lapatifolium*, *Epilobium adenocaulon*, *Poa annua* and *Taraxacum officinale* were less numerous (Markuszewski and Kopytowski, 2008).

Some species like *Convolvulus arvensis* are cosmopolitan plants and occur as weeds in the orchards of various countries: Argentina (Conticello and Gandullo, 1991); Egypt (Mashaly and Awad, 2003), Bulgaria (Tasseva, 2005), and Turkey (Ustuner and Ustuner, 2011). *Chenopodium album* is an example of a cosmopolitan one-year weed, frequently occurring in the orchards of South Korea (Jung et al., 1997), Argentina (Novo et al., 2000), New Zealand (Harrington et al., 2002), Canada (Rifai et al., 2002), Egypt (Mashaly and Awad, 2003), Bulgaria (Tasseva, 2005), and Turkey (Ustuner and Ustuner, 2011). To the group of species commonly occurring in the orchards of different countries and continents belong, according to the previously cited authors: *Stellaria media*, *Capsella bursa-pastoris*, *Echinochloa crus-galli*, and *Polygonum aviculare*. This means that the anthropogenic factor − the technology of cultivating the fruit trees − has an important influence on the species composition of orchard synanthropic flora, including weeds. The success of particular species, measured by the number of plants, depends on tolerance to herbicides, long period of germination (*Geranium pusillum*, *Viola arvensis*, *Capsella bursa-pastoris*), large number of seeds (*Chenopodium album*), anemochores (*Asteraceae*, *Epilobium adenocaulon*), and permanence of seeds in the soil (*Amaranthus retroflexus*, *Echinochloa crus-galli* (Tymrakiewicz, 1976; Mowszowicz, 1984). The common occurrence of perennials, such as *Equisetum arvense*, *Epilobium adenocaulon* is connected to the low sensitivity of the plants of these species to herbicides applied in orchards (Lisek, 2001). Orchards with a varied technology of soil management and varied lighting of the inter-rows and under the branches of trees, create conditions proper for the development of plants belonging to the different socio-ecological group. Plant mowing in the boundary stripes stimulated the development of flora characteristic of meadows and swarms, and their afforestation supported the development of species typical of shrub edges and deciduous woodland. The composition of flora in the examined orchards was modified by environmental conditions, succession, and the age of the orchard. A lack of tillage over the span of many years, favoured the development of perennial weeds; their compensation. Simultaneous occurrence of therophytes, hemicryptophytes, and geophytes creates difficulties for

providing a practical way to limit the number of weeds. The preferred method of protection integrates the various methods of weed control.

CONCLUSIONS

1. Synanthropic flora of orchards of central Poland near Skierniewice, Łowicz and Grójec consisted of 186 species of vascular plants belonging to 39 botanical families. Most frequently represented were *Asteraceae* (21%), *Poaceae* (15%), *Brassicacea* (8%) and *Fabaceae* (7%).
2. Around 60% of the species found in the examined orchards occurred occasionally or rarely, whereas 15% of the species were noted frequently or very frequently. Frequently occurring species were numerously represented in the herbicide fallow field under the trees, so they should be acknowledged as the most significant orchard weeds.
3. The most numerous group of the analysed flora constituted of therophytes (50%), which predominated over hemicryptophytes (31%) and geophytes (10%).
4. Apophytes − native species (59%) predominated over archeophytes (33%) and kenophytes (8%).
5. Among the vascular flora of the orchards examined, segetal species (26%) predominated over ruderal (21%) and meadow (19%) species.

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FLORA SYNATROPIJNA SADÓW CENTRALNEJ POLSKI

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S T R E S Z C Z E N I E

W sadach w centralnej Polsce w okolicy Skierniewic, Łowicza i Grójca badano florę synantropijną. W latach 2007-2010 wykonano 390 zdjęć fitosocjologicznych obejmujących ugór herbicydowy pod koronami drzew, murawę międzyrzędzi, ugór mechaniczny, uwrocia i miejsca wydeptywane, przydroża (pobocza dróg wewnętrznych), przypłocia i rowy melioracyjne W badanych sadach zarejestrowano występowanie 186 gatunków, należących do 39 rodzin botanicznych, z których najliczniejsze były *Asteraceae* (21%), *Poaceae* (15%), *Brassicaceae* (8%) i *Fabaceae* (7%). Spośród gatunków znalezionych w badanych sadach 60% występowało okazjonalnie lub rzadko. 15% gatunków, między innymi *Equisetum arvense*, *Polygonum aviculare*, *Chenopodium album*, *Amaranthus retroflexus*, *Stellaria media*, *Capsella bursa-pastoris*, *Convolvulus arvensis*, *Viola arvensis*, *Epilobium adenocaulon*, *Conyza canadensis*, *Taraxacum officinale*, *Poa annua*, *Echinochloa crus-galli*, występowało często lub bardzo często, przede wszystkim w ugorze herbicydowym i uznano je za najważniejsze chwasty sadów. Najliczniejszą grupę analizowanej flory stanowiły terofity (50%), które przeważały nad hemikryptofitami (31%) i geofitami (10%). Apofity – gatunki rodzime (59%) przeważały nad archeofitami (33%) i kenofitami (8%). Wśród flory naczyniowej badanych sadów przeważały gatunki segetalne (26%), ruderalne (21%) i łąkowe (19%).

Słowa kluczowe: rośliny synantropijne, chwasty, sad