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Participation of *Solidago canadensis* L. and *S. gigantea* AITON in abandoned fields communities in the Silesian Upland (Poland)

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Abstract: During last years leaving farmland without cultivation is very often phenomenon in Poland. The land is put into afforestration or building as well as left for spontaneous succession. The aim of the paper is to describe the role of two alien invasive species e.g. *Solidago canadensis* and *Solidago gigantea* in plant communities establishing on fallow land in the Silesian Upland (south Poland). In years 2003-2004 on the fields abandoned 10-20 years ago 47 phytosociological records were taken by the method of Braun-Blanquet. 23 of them present patches of the community with domination of *Solidago canadensis* and minor participation of *Solidago gigantea*. Moreover, *Solidago canadensis* plays a significant role in some other communities noted on the abandoned fields in the studied area. It occurs in more than 85% taken relevès.

Keywords: *Solidago canadensis*, *Solidago gigantea*, abandoned farmland communities, Silesian Upland (Poland).

Introduction

Leaving farmland without cultivation has become one of more important problems in Poland during last years. It is estimated that area of abandoned agriculture land in whole country exceeds 15,000 km^2 (Rocznik 2003; ROLA et al. 2004). They are small field patches belonging to private owners as well as

ground of former large-area state farms. The main reason of lying land fallow is fact that many branches of agricultural production are treated as unprofitable for farmers. Farmland is put into building or sometimes into corn again, large area is destined for planed afforestration (KUTYNA & LEŚNIK 2004; BADOWSKI et al. 2004, ROLA et al. 2004), the rest of abandoned fields is left for spontaneous succession. The problem of uncultivated crop fields and meadows has attracted the interest of conservation botanists, ecologists, foresters and economics (DUBIEL 1984; DUBIEL 1988; MICHALIK 1990; DUBIEL & KOZAK 2004; BARABASZ-KRASNY 2002; NOWAK et al. 2002; KUTYNA & LEŚNIK 2004; ROLA et al. 2004). According to the European Community law each EU country is obliged to protect its local biodiversity, including rural habitats (Phare 1999). Leaving farmland without cultivation eliminates its the most characteristic elements and causes its degeneration (ŁABZA 1996, HOCHÓŁ et al. 1998; WARCHOLIŃSKA 1998; ŁABZA et al. 2003). Often during spontaneous succession non-native invasive species are successful in penetration onto abandoned farmland as habitat strongly changed by human activity (ADAMOWSKI & KNOPIK 1996; FALIŃSKI 1998; REJMÁNEK 1999; ADAMOWSKI & BOMANOWSKA 2004).

The aim of the paper is to described the role of two established in Polish flora newcomers (kenophytes) of American origin (ZAJĄC et al. 1992) - *Solidago canadensis* and *S. gigantea* in the communities formed on abandoned fields in the Silesian Upland (south Poland).

Material and methods

The researched area was the Silesian Upland located in southern Poland (KONDRACKI 1994). The region is characteristic of strong urbanisation and industrialisation, the biggest in Poland industrial centre - the Upper Silesian Industrial District is located there. But still, according to official data, cropland comprise more than 40% of the whole area of the Silesian Upland (Rocznik 2001, Rocznik 2002). In many parts of the region farmland are uncultivated. Besides reasons mentioned above, pollution is one more cause for keeping fields out of crop.

There were made during 2003-2004 years 47 relevès taken by the method of Braun-Blanquet on fields uncultivated for 10-20 years. Names and systematic of plant communities are based on MATUSZKIEWICZ (2001). Names of plant species were given after MIREK et al. (2002).

Results and discussion

Solidago canadesis occurred in almost 85% of taken 47 relevès. It was noted in the patches of *Calamagrostietum epigeji, Convolvulo arvensis-Agropyretum repentis* and other phytocoenoses (grass-dominated rump communities of the *Molinio-Arrhenatheretea* class and communities with *Betula pendula* ROTH and *Robinia pseudoacacia* L.), but its highest participation was recorded in the community with *Solidago canadesis* (constancy V and high coefficient of cover

5837). It was often accompanied by another alien goldenrod species - *Solidago gigantea*, not reaching so high constancy and cover (IV and 330) - table 1.

Table 2 presents 10 chosen from 23 relevès describing *Solidago canadensis* community. *Solidago canadensis* was a dominant, sometimes massive growing species. *Solidago gigantea* occurred frequently but not abundantly. An important role in the structure of the community were also played by some ruderal species e.g. *Cirsium arvense* (L.) SCOP. and *Artemisa vulgaris* L. (both constancy IV), *Equisetum arvense* L. of the *Agropyretea intermedio-repentis* class (constancy IV), segetal weed *Vicia hirsuta* (L.) GRAY (V) and some meadow species of the *Molinio-Arrhenatheretea* class, like *Achillea millefolium* L. (V), *Taraxacum officinale* F. H. WIGG. (V) and *Poa pratensis* L. (V). Among accompanying species were plants character of xerothermic grasslands (*Campanula rapunculoides* L., *Centaurea scabiosa* L., *Coronilla varia* L., *Falcaria vulgaris* BERNH.), midfield thickets (*Rhamnus cathartica* L., *Prunus spinosa* L., *Rosa canina* L.) and woodlands (*Athyrium filix femina* (L.) ROTH, *Dryopteris filis-mas* (L.) SCHOTT, *Scrophularia nodosa* L., *Acer negundo* L. and protected by law orchid *Epipactis helleborine* (L.) CRANTZ.). They were sporadic elements of the community as well as some rare weeds like *Lathyrus tuberosus* L. and *Melampyrum arvense* L. treated as endangered for Polish segetal flora (WARCHOLIŃSKA 1998).

Solidago canadensis and *S. gigantea* are treated as invasive plants in habitat of different kind (e.g. wastelands, meadows, and riverbanks) in Poland (TOKARSKA-GUZIK 2003, WOŹNIAK 2003; WOŹNIAK, DYLEWSKA 2004) and in many European countries (WEBER 1998, BOTTA-DUKÁT 2002; TERPÓ 2003, ZALIBEROVÁ & JAROLÍMEK 2003). Our results show that these goldenrod species, especially *Solidago canadensis,* could be also invasive plant on abandoned farmland in the studied area. *Solidago canadensis* creating one-species-dominating communities limits natural succession. The investigation should be continued to estimate whether these communities could be treated as permanent element of the vegetation

References

ADAMOWSKI W., BOMANOWSKA A. (2004): Obce gatunki drzewiaste na gruntach porolnych w Puszczy Białowieskiej. - Mat. Konf. Nauk. "Sukcesja wtórna roślinności na gruntach porolnych". XXVIII Konferencja "Rejonizacja chwastów segetalnych w Polsce". p. 15. - Olsztyn.

ADAMOWSKI W., KNOPIK A. (1996): Ornitochorous species penetration onto abandoned farmland during secondary succession. - Phytocoenosis 8 (N.S.) Seminarium Geobotanicum 4: 97-110.

BADOWSKI M., ROLA J., DOMARADZKI K. (2004): Graminicydy do ograniczania rozwoju roślin trawiastych na nowych plantacjach sosny. Mat. Konf. Nauk. "Sukcesja wtórna roślinności na gruntach porolnych". XXVIII Konferencja "Rejonizacja chwastów segetalnych w Polsce. p. 17. - Olsztyn.

BARABASZ-KRASNY B. (2002): Sukcesja roślinności na łąkach, pastwiskach i nieużytkach porolnych Pogórza Przemyskiego. - Fragm. Flor. Geobot. Polonica, Suppl., 4: 3-81.

BOTTA-DUKÁT Z., DANCZA I., RÈVÈSZ A. (2002): Relationship between climate and geographical distribution of *Solidago gigantea* Ait. In Hungary. - Abstracts of Conference "Anthropization and environment of rural settlements. Flora and Vegetation". Uzhorod & Kostryno, Ukraine. p. 16-17. - Phytosociocentre, Kyiv.

DUBIEL E. (1984): Dolina Wierzbanówki: 5. Rozwój roślinności na odłogach. - Zeszyty Naukowe UJ, Prace Bot., 12: 97-112.

DUBIEL E. (1988): Dolina Wierzbanówki: 15. Wpływ wypasu bydła i owiec na zbiorowiska odłogów i łąk. - Zeszyty Naukowe UJ, Prace Bot., 17: 63-77.

DUBIEL E., KOZAK M. (2004): Wtórna sukcesja roślinności na opuszczonych użytkach rolnych południowej części Wyżyny Krakowsko-Częstochowskiej. Zróżnicowanie i przemiany środowiska przyrodniczo-kulturowego Wyżyny Krakowsko-Częstochowskiej. - in print.

FALIŃSKI J.B. (1998): Invasive alien plants and vegetation dynamics. - In: Starfinger U., Edwards K., Kowarik I. And Williamson M. (eds.): Plant invasions. Ecological consequences and human responses. p. 3-21. - Backhuys Publishers, Leiden, The Netherlands.

HOCHÓŁ T., ŁABZA T., STUPNICKA-RODZYNKIEWICZ E. (1998): Zachwaszczenie wieloletnich odłogów w porównwniu do stanu na polach uprawnych. - Bibliotheca Fragmenta Agronomica 5: 115-123.

ŁABZA T., HOCHÓŁ T., STUPNICKA-RODZYNKIEWICZ E. (2003): Zmiany w florze odłogów i sąsiadujących z nimi pól uprawnych w latach 1993-2001. Zesz. Probl. Post. Nauk Roln. 490: 143-152

KONDRACKI J. (1994): Geografia fizyczna Polski. Mezoregiony fizyczno-geograficzne. pp.339. - PWN, Warszawa.

KUTYNA I., LEŚNIK T. (2004): Porównanie zachwaszczenia upraw leśnych na gruntach porolnych zalesionych według koncepcji duńskiej i Polskiej na terenie Nadleśnictwa Dobrzany. - Mat. Konf. Nauk. "Sukcesja wtórna roślinności na gruntach porolnych". XXVIII Konferencja "Rejonizacja chwastów segetalnych w Polsce. p. 6. - Olsztyn.

ŁABZA T. (1996): Odłogowanie pól jako przyczyna degradacji terenów rolniczych. - Mat. Konf. Nauk. Gospodarka terenami zniszczonymi działalnością człowieka". PAN, Inst. Podstaw Inżynierii Środowiska, p. 151-160. - Zabrze.

MATUSZKIEWICZ W. (2001): Przewodnik do oznaczania zbiorowisk roślinnych Polski. Vademecum Geobotanicum 3: 5-537. - PWN, Warszawa.

MICHALIK S. (1990): Sukcesja roślinności na polanie reglowej w Gorczańskim Parku Narodowym w okresie 20-tu lat, w wyniku zaprzestania wypasu. - Prądnik, Prace Muz. Szafera, 2: 137-148.

MIREK Z., PIĘKOŚ-MIRKOWA H., ZAJĄC A., ZAJĄC M. (2002): Flowering Plants and Pteridophytes of Poland. A checklist. Pp. 442. - W.Szafer Institute of Botany, Polish Academ of Sciences. Kraków.

NOWAK T., TOKARSKA-GUZIK B., SZYSZKA L., PALIWODA A., KAPICA A. (2002): The flora differentiation of abandoned fields in the Silesia Upland and its surroundings. - Abstracts of Conference "Anthropization and environment of rural settlements. Flora and Vegetation". Uzhorod & Kostryno, Ukraine. p. 63-64. - Phytosociocentre, Kyiv.

Phare 1999. Pilotażowy projekt rozwoju terenów wiejskich - programy rolnośrodowiskowe.

REJMÁNEK M. (1999): Invasive plant species and invasible ecosystems. - In: Sandlund O.T., Schei P.J. & Viken Å. (eds). Invasive species and biodiversity menagement. p. 79-102. - Kluwer Academic Publishers, Dordrecht-Boston-London.

Rocznik Statystyczny Rzeczpospolitej Polskiej. (2003): - Główny Urząd Statystyczny w Warszawie.

Rocznik statystyczny województwa śląskiego. (2001): - WUS, Katowice.

Rocznik statystyczny województwa śląskiego. (2002): - WUS, Katowice.
ROLA J. ROLA H., BADOWSKI M., SEKUTOWSKI K., DOMARADZKI K. (2004): Metody ograniczania naturalnej sukcesji roślinnej na gruntach porolnych (odłogi) przeznaczonych pod zalesienie. - Mat. Konf. Nauk. "Sukcesja wtórna roślinności na gruntach porolnych". XXVIII Konferencja "Rejonizacja chwastów segetalnych w Polsce. p. 8. - Olsztyn.
TERPÓ A. (2003): Synanthropic newcommers (kenopytes-neophytes) in Hungarian flora. - In: Zając A., Zając M., Zemanek B. (eds): Phytogeographical problems of synanthropic plants. p. 331-338. Institute of Botany, Jagiellonian Uniwersity - Cracow.
TOKARSKA-GUZIK B. (2003): The expansion of some alien plant species (neophytes) in Poland. - In: Child L.E., Brock J.H., Brundu, Prach, K., Pyšek P., Wade P.M. and M. Williamson (eds.). Plant Invasions: Ecological Threats and Management Solution, p. 147-167. - Backhuys Publishers, Leiden, The Netherlands.
WEBER E. (1998): The dynamics of plant invasions: a case study of three exotic goldenrod species (*Solidago* L.) in Europe. - Journal of Biogeography 25: 147-154.
WARCHOLIŃSKA A.U. (1998): Właściwości zagrożonych segetalnych roślin naczyniowych Polski. - Acta Univ. Lodz. Folia Bot., 13: 7-14.
WOŹNIAK G. (2003): The neophyte establishment in plant communities of post-industrial waste sites (Upper Silesia; Poland) - In: Child L.E., Brock J.H., Brundu, Prach, K., Pyšek P., Wade P.M. and M. Williamson (eds.). Plant Invasions: Ecological Threats and Management Solution, p. 169-179. - Backhuys Publishers, Leiden, The Netherlands.
WOŹNIAK G., DYLEWSKA Z. (2004): *Solidago canadensis* L. i *Solidago gigantea* Aiton w zbiorowiskach łąkowych. - Mat. Konf. Nauk. "Sukcesja wtórna roślinności na gruntach porolnych". XXVIII Konferencja "Rejonizacja chwastów segetalnych w Polsce. p. 50. - Olsztyn.
ZAJĄC M., ZAJĄC A. TOKARSKA-GUZIK B. (1992): Kenophytes in the flora of Poland: list, status and origin. - Phytocoenosis 10 (N.S.) Suppl. Cartographiae Geobotanicae 9: 107-116.
ZELIBEROVÁ M., JAROLÍMEK I. (2003): Distribution of the plant communities of the order *Convolvuletalia sepium* in Slovakia. - In: Zając A., Zając M., Zemanek B. (eds): Phytogeographical problems of synanthropic plants. p. 283-291. - Institute of Botany, Jagiellonian Uniwersity - Cracow.

Tab. 1. Participation of *Solidago canadensis* and *S. gigantea* in fallow land communities in the studied area.

Distinguished communities	Community with *Solidago canadensis*	*Convolvulo arvensis-Agropyretum repentis* FELFÖLDY 1943	*Calamagrostietum epigeji* JURASZEK 1928	Other communities
Relevès number	23	11	6	7
Species no. in relevè	12-37	17-25	12-27	11-28
Average species no. in relevè	24	21	16	25
Total species no.	122	100	58	49
pH	5.0-7.0	4.0-7.0	4.5-7.0	4.5-7.5
Average pH	6.0	5.6	5.6	5.8
Solidago canadensis	V^{3-5} 5837	III^{+-2} 251	IV^{+} 88	II^{r-1} 44
Solidago gigantea	IV^{r-2} 330	II^{r-1} 292	.	I^{r+} 2
Ch. Ass. *Convolvulo arvensis-Agropyretum repentis*:				
Elymus repens	II^{r-2} 164	V^{2-5} 5432	III^{+-1} 87	III^{+-2} 387
Convolvulus arvensis	III^{r-1} 69	V^{r-1} 53	$I^{r}1$	$I^{r}1$
Ch. Ass. *Calamagrostietum epigeji*:				
Calamagrostis epigejos	III^{+-2} 87	II^{1} 188	V^{3-5} 6250	II^{+-1} 285

Tab. 2. Community with *Solidago canadensis*.

Successive number	1	2	3	4	5	6	7	8	9	10	
Relevé field number	47	32	46	44	31	34	1	43	33	36	
Locality	24	20	22	21	19	17	10	9	18	15	
Slope in o	0	0	0	0	3	0	0	15	2	0	
Eksposure					SW			NE	NE		
Relevé date	18.0 7 2004	16.0 7 2004	18.0 7 2004	14.0 7 2004	16.0 7 2004	16.0 7 2004	15.0 7 2003	23.0 7 2004	16.0 7 2004	22.0 7 2004	
pH (1-5) cm	6.5	7.0	5.5	6.0	6.5	6.5	7.0	5.0	5.5	6.0	
Area of sample plot in m^2	100	100	100	100	100	100	100	100	100	100	
Number of species in relevé	12	22	21	19	38	23	25	24	35	34	
Solidago canadensis	5.5	5.5	5.5	5.5	5.5	4.4	4.4	4.4	3.3	3.3	V
Solidago gigantea	1.2	1.1	+	+	+	1.1	+	r	1.2	+	V
Ch. *Artemisietea vulgaris*:											
Cirsium arvense	.	1.1	r	.	+	+	+	+	1.1	r	IV
Artemisia vulgaris	1.1	+	+	.	r	.	+	1.1	1.1	.	IV
Tanacetum vulgare	1.1	.	+.2	+.2	+.2	.	1.1	.		.	III
Melandrium album	.	r	1.1	.	r	+	.	.	+	.	III
Galium aparine	.	+	.	.	r	r	.	.	+	.	II
Medicago lupulina	.	.	r	+	.	.	1.1	.	.	.	II
Conyza canadensis	+.2	.	.	r	.	r	.	.	.	.	II
Tussilago farfara	+.2	.	.	.	.	.	+.2	.	+	.	II
Picris hieracioides	.	.	.	.	r	r	.	.	.	+	II
Rumex crispus		r					.	r	r		II
Ch. D. *Agropyretea intermedio-repentis*:											
Equisetum arvense	+	.	+	+	+	.	+	2.2	+	.	IV

Convolvulus arvensis	.	.	.	r	r	.	.	1.1	r	+	III
Poa angustifolia	.	.	.	.	+	.	.	.	.	2.2	

Sporadic species: *Elymus repens* +/6/, 1.2/9/; *Poa angustifolia* +/5/, 2.2/10/; *P. compressa* +/8/.

Ch. *Stellarietea mediae:*

Vicia hirsuta	1.2	r	1.1	+	1.1	+	+	+	2.2	1.2	V
Vicia angustifolia	.	+		+			.	r	r	r	III
Vicia tetrasperma	.	1.1	+	.	r	.	.	.	r	.	II
Myosotis arvensis	.	.	.	.	+	.	.	r	r	r	II
Fallopia convolvulus	.	+	.	.	.	+	.	.	r	.	II
Galeopsis tetrahit	.	+	.	.	.	+	.	.	r	.	II

Sporadic species: *Amaranthus retroflexus* +/4/; *Consolida regalis* r/10/; *Erophila verna* r/1/; *Lapsana communis* r/7/; *Lathyrus tuberosus* 1.1/8/; *Melampyrum arvense* +/10/; *Oxalis stricta* 1.1/7/; *Silene vulgaris* +/1/; *Sinapis arvensis* r/2/; *Sonchus arvensis* r/9/; *Stellaria media* r/4/; *Veronica arvensis* r/4/; *V. persica* +/4/; *Vicia villosa* +.2/7/.

Ch. *Molinio-Arrhenatheretea:*

Achillea millefolium	1.2	+	1.1	1.1	+	r	1.1	.	+	1.2	V
Taraxacum officinale	.	+	1.1	+	r	+	+	+	r	2.2	V
Poa pratensis	.	.	r	+	r	+	1.1	1.1	r	.	IV
Dactylis glomerata	.	.	.	r	r	.	.	1.1	+.2	1.2	III
Viccia cracca	.	r	.	r	.	1.1	.	1.1	+	.	III
Crepis biennis	.	.	.	.	r	+	.	1.1	r	r	III
Heraclum sphondylium	.	.	.	.	.	.	.	1.2	+	1.1	II
Deschampsia caespitosa	.	.	.	.	+.2	+.2	.	.	1.1	.	II
Rumex acetosa	.	.	+	1.1	1.1	.	.	.	.	.	II
Trifoilum pratense	.	.	r	.	.	.	r	r	.	.	II

Sporadic species: *Alopecurus pratensis* +/6/; *Arrhenatherum elatius* 1.1/8/, 1.2/10/; *Carex hirta* 1.2/10/; *Carum carvi* r/4/; *Cerastium vulgatum* +/1/; *Daucus carota* +/5/, 1.1/7/; *Festuca rubra* 1.1/8/; *Galium mollugo* r/2/, 1.2/10/; *Knautia arvensis* r/10/; *Lathyrus pratensis* r/10/, +/9/; *Lotus corniculatus* r/8/; *Pastinaca sativa* r/5/, +/10/; *Phleum pratense* r/4/, +/6/; *Poa trivialis* +/5/; *Potentilla reptans* +/3/; *Ranunculus repens* +/9/; *Rhinanthus serotinus* +/8/; *Trifolium repens* r/5/, +/3/; *Valeriana officinalis* 1.1/5/.

Others:

Calamagrostis epigejos 1.2 1.1 1.1 . 1.1 . 1.2 . . . III

Sporadic species: Acer negundo +/6/; *Aegopodium podagraria* r/3/; *Agrostis capillaris* r/10/; *Armeria maritima ssp. elongata* r/1/; *Athyrium filix-femina* r/9/; *Campanula rapunculoides* 1.1/10/; *Centarea scabiosa* r/10/; *Coronilla varia* +.2/5/; *Dryopterys filis-mas* r/9/; *Epipactis helleborine* r/1/; *Erigeron annuus* r/5/; *Euphorbia esula* 1.1/10/; *Falcaria vulgaris* +.2/10/; *Fragaria vesca* 1.1/5/; *F. xananassa* r/5/; *Fraxinus pennsylvanica* r/10/; *Hieracium sabaudum* +/10/; *Hypericum maculatum* r/8/, +.2/5/; *Juncus effusus* r/3/; *Medicago xvaria* +/6/; *Mentha arvensis* r/9/; *Prunus spinosa* +/5/; *Radiola linoides* +/1/; *Rhamnus cathartica* r/5/; *Rosa canina* r/5/; *Salix caprea* r/6/; *Scabiosa ochroleuca* r/5/; *Scrophularia nodosa* r/2/; *Stellaria graminea* +/6/; *Symphytum officinale* r/9/; *Trifolium hybridum* r/10/; *Viola tricolor* 1.1./1/.