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IMPORTANCE OF MIDFIELD THICKETS IN APHID DISTRIBUTION

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Abstract: The investigations conducted in 1994 and 1996 concerned aphids infesting fields and neighbouring semi-natural habitats – midfield thickets with trees and the vegetation growing on the ditch margins. Aphids were caught into Moericke traps placed at the plant level. The material collected was studied to determine aphid number, dominance of individual species, similarity of dominance structure of aphid communities (Renkonen Index) and diversity of aphid communities (Shannon-Weaver Index). Aphids were collected in the field and in the natural habitats neighbouring the field. In both years black bean aphid (*Aphis fabae* Scop.) was either the dominant or sub-dominant species in every habitat studied. A relative species diversity of aphids occurring in semi-natural habitats was significantly higher than that in the adjacent field. The results of these investigations indicate that the crop affects aphid fauna flying onto neighbouring midfield thickets.

Key words: midfield thickets, aphid communities

INTRODUCTION

The agricultural landscape of Poland is dominated by small fields, limited by boundaries, bushes, thickets with trees and midfield woodlots. The natural midfield vegetation affects ecological processes in the surrounding agroecosystem. The knowledge of the vegetation cover and its entomofauna can enhance the environmental and agricultural evaluation of these habitats and defining their applicability to integrated plant protection (Barczak et al. 2000; Lagerlöf and Wallin 1988). Semi-natural environments being a permanent part of the agroecosystem are a source of entomophagous insects inhibiting the occurrence of pests. However, at the same time they are considered to be reservoirs of pest organisms and, as a result, are treated as crop-threatening (Kaczorowski and Bennewicz 1995; Bennewicz and Kaczorowski 1997). Midfield thickets can act as an ecological corridor which would make harmful insects spread easier (Barczak et al. 2000). The reports available show that fields cross-divided with trees and wild-growing plants are more abundant in beneficial insects (Boczek 1992) and that crops cultivated in these fields are less infested by pests (Barczak 1992). The most dangerous pests include aphids (*Homoptera: Aphidodea*).

The aim of the present research was to determine the aphids' occurrence in midfield thickets and their role in infesting adjacent fields, as well as to define the relationships between these environments and adjacent crop plantations.

INVESTIGATED SITES

The areas studied are located in the province of the South-Baltic Lake District, macro region of Chełmińsko-Dobrzyńskie Lake District, micro region of Chełmińskie Lake District. The area is situated in the Kujawy-and-Pomorze Province, Toruń region, Lubianka commune, and the village of Leszcz (Kondracki 2000). According to the geobotanical division of Poland, the area analysed falls into the District of Dobrzyńska Plateau (Pawłowski 1972). The Chełmińskie Lake District is a morainic plateau where brown soils on light moraine clay and podzolic on outwash sand prevail. The region is mostly of agricultural use (Kondracki 2000). Potential flora is made up of deciduous forest, of riparian type *Tilio-Carpinetum* (Matuszkiewicz et al. 1995).

MATERIAL AND METHODS

The research areas covered plateau and slope of a 300 m-long 10 m-wide ditch. The 'ditch margin' area was located on a ditch section grown with herb layer, the second area, 'thickets with trees', covering the ditch section with trees and bushes.

The research was carried out over 1994–1996, however the year 1995 has not been covered by the present paper due to a small number of aphids caught. Over successive years, sugar beet, wheat and triticale were grown in the field.

Over the research years the vegetation cover of the investigated areas was evaluated using the method of phytosociological records by Braun-Blanquet (Pawłowski 1972). Plant communities were defined following Matuszkiewicz (2001).

Aphids were caught into yellow plastic Moericke traps about 12 cm in diameter set at the herbs–top level. The traps were filled with 10% ethylene glycol solution. Insects were collected from the traps every ten days. Each research area was covered with three traps placed 10 m away one from another. The evaluated faunistic and ecological characteristics of the collected material included the abundance of aphids, their dominance structure – D (participation in a given community in percentages): D4 – dominants: ≥ 20% individual specimens, D3 – subdominants: 10% – 19.9%, D2 – relatively numerous species: 3% – 9.9%, D1 – scarce species: < 3% (Klimaszewski et al. 1980), and species diversity (Shannon-Weaver Index) (Witkowski 1970). In a statistical analysis Hutchison's test was used to estimate a differences between Shannon's index values (H') of two compared aphid communities (Hutcheson 1970). The evaluation of the characteristics of the insect communities defined based on the abundance and diversity was supplemented by the analysis of dominance structure similarity, measured with Renkon's Coefficient Re (communities similar at Re from about 50%) (Pawlikowski 1985). Names of plant species were given after Rutkowski (1998), while scientific names for aphids – after Wojciechowski and Czylok (1990).

RESULTS AND DISCUSSION

1. Characteristics of the investigated sites

The plant cover of the two researched areas was much affected by an intensive farming in the all-surrounding fields (Tab. 1). The 'ditch margin' was grown almost exclusively by the herb layer, except for single individuals of *Prunus spinosa*. The herb layer was most dominated by grasses. *Festuca arundinaceae* was most numerous and together with other species of *Molinio-Arrhenatheretea* formed *Potentillo-Festucetum arundinaceae* community. *Poa trivialis, Festuca rubra, Elymus repens, Convolvulus arvensis, Equisetum arvense, Lathyrus palustris* and *Ranunculus repens* were also highly abundant. The phytocenosis is observed to show a considerable share of some species of *Atremisietea vulgaris,* including *Cirsium arvense* and *Artemisia vulgaris*. Single individuals of segetal species of *Stellarietea mediae,* e.g.: *Tussilago farfara, Chenopodium album, Papaver rhoeas* and *Apera spica-venti* migrated into the ditch herb plants. *Convolvulo arvensis, Agropyretum repentis* community was developing on the 'ditch margin' surface as well as 'thickets with trees' surface which was partially in its initial stage of overgrowing with bushes. Similarly to the first community, here also grasses dominated. *Elymus repens* was especially abundant and was accompanied by *C. arvensis, Bromus inermis* and *Poa pratensis* whose cover was much smaller. Bushes were represented by single *P. spinosa* and *Rosa canina*. The surface of 'thickets with trees' was dominated by trees and bushes of *Querco-Fagetea*. *Quercus robur* was most numerous on the boundary analysed reaches 'monumental' size. A considerably smaller size was observed of other tree species: *Carpinus betulus, Acer platanoides* and *Tilia platyphyllos*. The bush layer was made up of *Rhamno-Prunetea* species*: P. spinosa, Crataegus laevigata, Rhamnus catharticus, R. canina, Rosa tomentosa* and *Sambucus nigra*. Under the canopy of trees and bushes, similarly to the previously discussed communities, *Poa nemoralis, E. repens* and *B. inermis* grasses were most frequent. The anthropogenic effects are visible in the considerable share of *Artemisietea* species. *Artemisia vulgaris* and *Chenopodium album* are quite frequent, coming from the neighbouring agrophytocenoses.

2. Faunistic analysis

2.1. Species spectrum and number of aphids

Aphid development dynamics depends considerably on the course of weather in a given year, especially meteorological conditions in spring months (Gabriel et al. 1964; Opyrchałowa and Goos 1973). For that reason when discussing the results the attention was put to the course of temperature and precipitation over the vegetation period. Meteorological data was used, as reported by the Plant Breeding Station at Kowroz (Figs. 1a, b). The spring of 1994 was warm. July and August recorded the highest mean temperatures. Higher rainfall was recorded as late as September. The spring of 1996 was cold and wet and the summer – chilly, cloudy and moist, only June was relatively warm (Fig. 1b). All that created totally different

Table 1. Brushwood communities: *Querco-Fagetea* community (reliv 7, 8), *Convolvulo arvensis-Agropyretum repentis* (reliv 5, 6), *Potentillo-Festucetum arundinaceae* (reliv 1, 2, 3, 4)

Successive number	1	2	3	4	5	6	7	8
Field number of releve	27	26	25	9	8	11	24	12
Area of record	A	A	A	A	A	B	B	B
Year	1994	1994	1994	1996	1996	1996	1994	1996
Month	07	07	07	07	07	07	07	07
Day	7	7	7	11	11	11	7	11
Cover tree layer (%)	0	0	0	0	0	0	45	95
Cover shrub layer	0	0	0	1	0	20	25	5
Cover herb layer	75	85	100	95	95	95	50	20
Number of species	12	11	28	17	18	20	36	17
Ch. *Querco-Fagetea*								
Carpinus betulus a	.	.	.	.	.	.	1	1
Quercus robur a	.	.	.	.	.	.	3	5
Acer platanoides a	.	.	.	.	.	.	+	1
Alnus glutinosa a	.	.	.	.	.	.	+	.
Pyrus communis a	.	.	.	.	.	.	+	.
Tilia cordata b	.	.	.	.	.	.	+	.
Tilia platyphyllos b	.	.	.	.	.	.	.	1
Poa nemoralis	.	.	.	.	.	.	.	2
Scrophularia nodosa	.	.	.	.	.	.	+	.
Ch. *Rhamno-Prunetea*								
Crataegus laevigata b	.	.	.	.	.	.	+	+
Prunus spinosa b	.	.	.	+	.	2	2	+
Rhamnus catharticus b	.	.	.	.	.	.	+	+
Rosa canina b	.	.	.	.	.	+	.	+
Rosa tomentosa b	.	.	.	.	.	.	+	.
Ch. *Stellarietea mediae*								
Chenopodium album	.	.	+	.	.	+	1	+
Tussilago farfara	+	+	+	+	.	.	.	.
Matricaria perforata	.	.	.	.	+	+	+	.
Apera spica-venti	.	.	+	.	.	.	.	.
Papaver rhoeas	.	.	+	.	.	.	.	.
Polygonum heterophyllum	.	.	.	.	.	.	+	.
Bilderdykia convolvulus	.	.	.	.	.	+	.	.
Viola arvensis	.	.	.	.	.	.	+	.
Anchusa arvensis	.	.	.	.	.	.	+	.
Myosotis arvensis	.	.	.	.	.	+	.	.
Ch. *Artemisietea vulgaris*								
Artemisia vulgaris	1	+	1	.	+	+	1	+
Cirsium arvense	.	+	2	+	+	.	+	.
Silene alba	.	.	+	.	+	+	+	.
Rubus caesius b	.	.	+	+	.	.	+	.
Hypericum perforatum	.	.	+	+	.	.	+	.
Medicago sativa	.	.	+	+	+	.	.	.
Tanacetum vulgare	.	.	+	.	+	.	+	.
Urtica dioica	.	.	+	.	.	1	+	.
Epilobium hirsutum	+	+	.	.	.	.	.	.

Geum urbanum	.	.	.	.	.	.	+	+
Anthriscus sylvestris	.	.	.	.	+	.	.	+
Lamium album	.	.	.	.	+	+	.	.
Arctium tomentosum	.	.	.	.	.	+	+	.
Solidago gigantea	.	.	.	.	.	.	+	.
Impatiens parviflora	.	.	.	.	.	.	+	.
Mycelis muralis	.	.	.	.	.	.	+	.
Galium aparine	.	.	.	.	.	+	.	.
Ballota nigra	.	.	.	.	.	.	+	.
Conium maculatum	.	.	.	.	.	.	+	.
Arctium lappa	.	.	+	.	.	.	.	.
Capsella bursa-pastoris	.	.	.	.	.	+	.	.
Ch. *Convolvulo arvensis-Agropyretum repentis*								
Convolvulus arvensis	.	+	+	2	1	+	+	.
Equisetum arvense	1	+	+	+	.	.	.	.
Elymus repens	.	.	1	.	5	5	2	.
Cerastium arvense	.	.	.	+	+	.	.	.
Bromus inermis	.	.	.	.	.	1	1	.
Ch. *Potentillo-Festucetum arundinaceae*								
Rumex crispus	+	+	+	+	+	.	.	.
Festuca arundinacea	3	4	4	4	.	.	.	.
Dactylis glomerata	.	.	+	+	+	.	+	.
Poa trivialis	+	1	1	.	+	+	.	.
Taraxacum sect.*Vulgaria*	.	.	.	+	.	+	.	+
Potentilla reptans	.+	+.	+.	+	+	.	.	.
Lathyrus pratensis	.	1	+	.	.	.	.	.
Holcus lanatus	.	+	+	.	.	.	.	.
Poa pratensis	.	.	.	+	1	.	.	.
Festuca rubra	.	.	1	1	.	.	.	.
Trifolium hybridum	.	.	+	.	.	.	.	.
Juncus effusus	+	.	.	.	.	.	.	.
Arrhenatherum elatius	.	.	.	.	+	.	.	.
Heracleum sibiricum	.	.	+	.	.	.	.	.
Poa annua	.	.	.	.	.	.	.	+
Lolium perenne	+	.	.	.	.	.	.	.
Cerastium holosteoides	.	.	+	.	.	.	.	.
Plantago lanceolata	.	.	.	+	.	.	.	.
Phleum pratense	.	.	+	.	.	.	.	.
Ranunculus repens	1	.	.	.	.	.	.	.
Festuca pratensis	.	.	.	.	+	.	.	.

Sporadic species: *Sambucus nigra* b, 6 (+), 7 (2), 8 (+), *Galeopsis tetrachit* 6 (+), *Lycopus europaeus* 1 (+), *Allium oleraceum* 8 (1), *Calamagrostis epigeios* 7 (+), *Rumex acetosella* 3 (+)

Explanations: a – tree layer, b – shrub layer
Braun-Blanquet abundance degree: + – 0.1%, 1 – medium cover 5.0%, 2 – medium cover 17.5%, 3 – medium cover 37.5%, 4 – medium cover 62.5%, 5 – medium cover 87.5%
A – ditch margin, B – thicket with trees
Ch. – characteristic species

aphid development conditions over the two research years. Unfavourable meteorological conditions in 1996 decreased the aphid abundance, as compared with that of 1994 (Figs. 2a, b). The phenology of dominant aphid species showed that in 1996 aphids occurred later, especially on the 'ditch margin' and single individuals occurred to the end of August or the beginning of September, while in 1994 aphids were numerous after mid-May and the last aphids were recorded at the beginning of

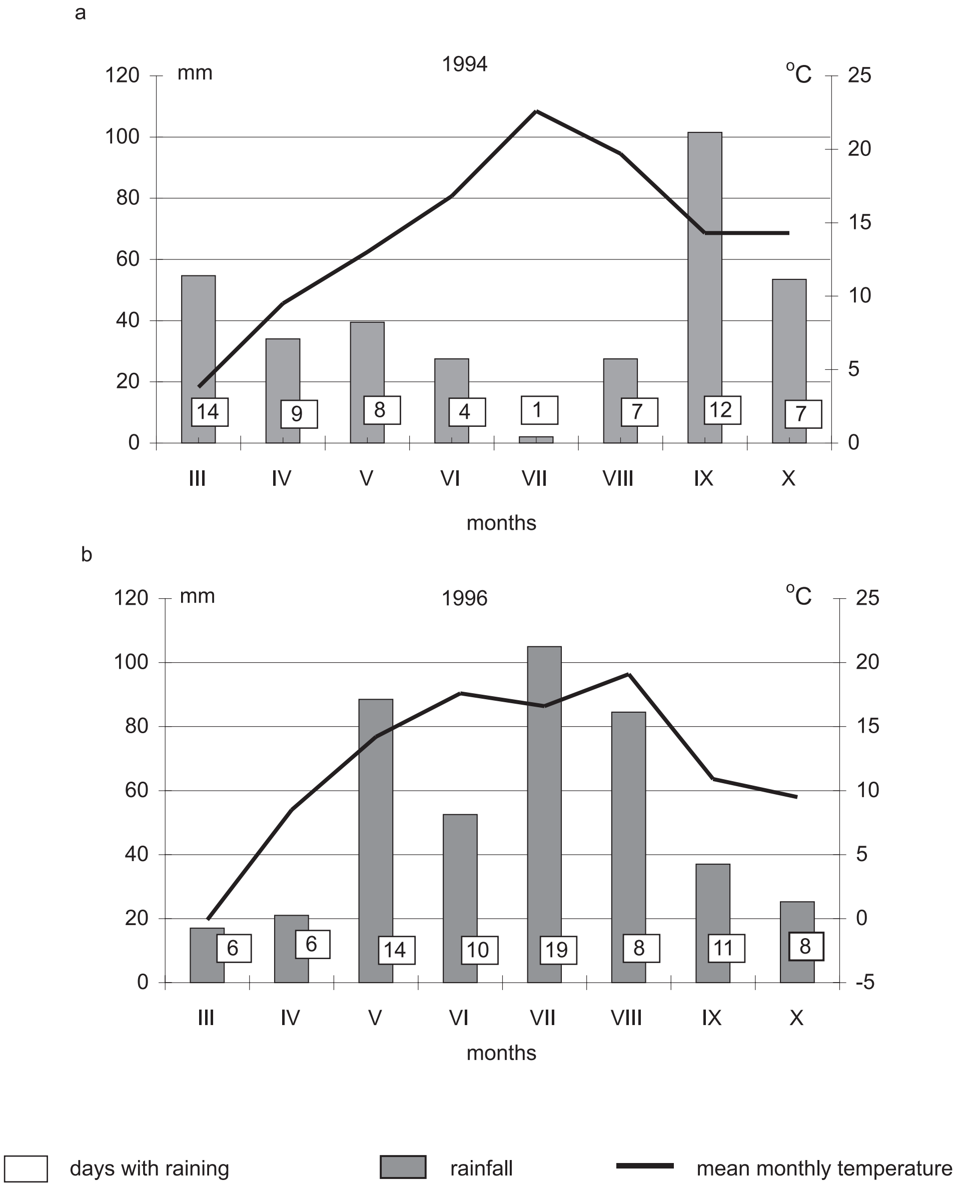

Fig. 1. Meteorological conditions

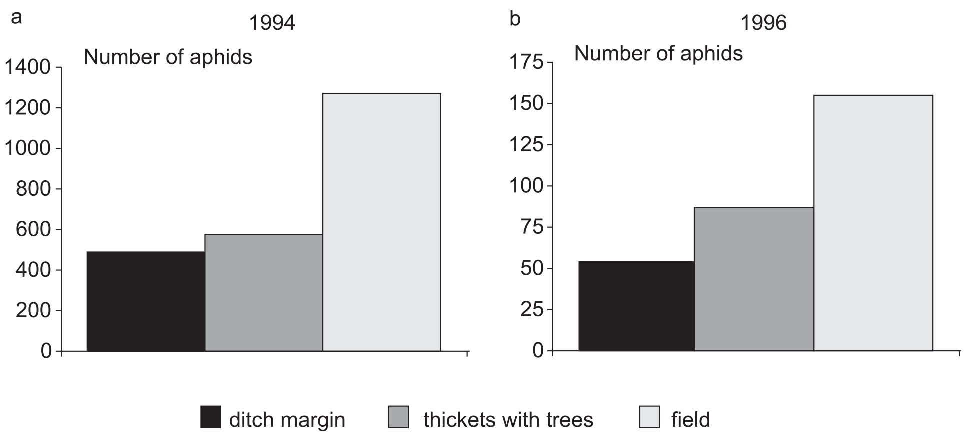

Fig. 2. Number of aphids (*Aphididea*) in midfield thickets and field

August (Figs. 3a, b). The warm spring of 1994 with mean temperatures from 14 to 19°C, accompanied by an average rainfall, created the most favourable conditions for aphid development (Gabriel et al. 1964). The rule observed here was confirmed by Müller's reports (1982), in which he showed that temperature optimal for flights and development of *A. fabae* population is 22–26°C. Over the two research years higher numbers of aphids were caught from the field than the two adjacent semi-natural habitats (Figs. 2a, b).

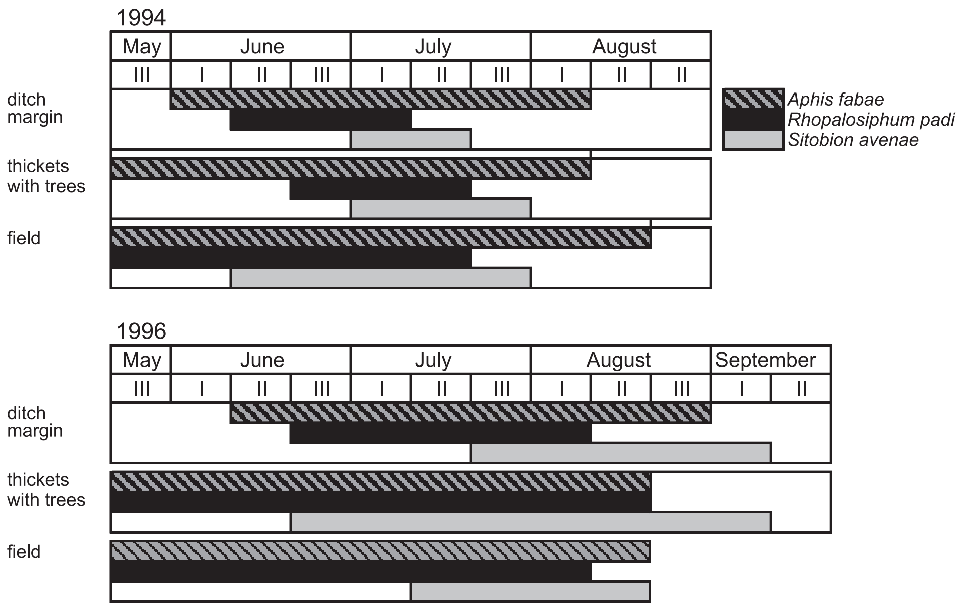

Fig. 3. Phenology of dominat aphid species

2.2. Aphid dominance structure

The higher numbers of aphids mentioned above were mostly due to the dominance of black bean aphid *A. fabae* (D4), one of the most dangerous pests of sugar beet crop (Tab. 2). Similar observations were made in 1992 when recorded an invasion of *A. fabae* onto sugar beet, accompanied by a considerably lower abundance of this pest on the boundary (Kaczorowski and Bennewicz 1995).

As for the 'ditch margin', in the two research years also *A. fabae* was a dominant species (Tab. 2). In 1994 in the field adjacent to the 'ditch margin' sugar beet was cultivated. High infestation of sugar beet plants with black bean aphid must have increased the abundance of this species in 'ditch margin' plant habitat. However, it

Table 2. Structure of relative abundance of aphids (*Aphidodea*) in midfield thickets

Species	1994			1996		
	ditch margin	thickets with trees	field	ditch margin	thickets with trees	field
Fam. ***Lachnidae***	D1	D1	D1	–	–	–
Fam. ***Anoeciidae***						
Anoecia corni (Fabricius)	D1	D1	D1	–	D1	–
Fam. ***Phyllaphididae***	D1	–	–	–	–	–
Fam. ***Chaitophoridae***	–	D1	–	–	–	–
Fam. ***Aphididae***						
Aphis fabae Scopoli	D4	D4	D4	D4	D3	D4
Aphis sambuci Linnaeus	–	–	–	D1	D1	D1
Acyrthosiphon pisum (Harris)	D1	D1	D1	D1	D2	–
Amphorophora rubi (Kaltenbach)	D1	D1	D1	–	D1	–
Aulacorthum solani (Kaltenbach)	–	–	D1	–	–	–
Brevicoryne brassicae (Linnaeus)	–	D1	–	–	–	–
Brachycaudus cardui (Linnaeus)	–	D1	D1	–	–	–
Capitophorus elaeagni (del Guercio)	–	–	–	–	D1	–
Cavariella aegopodii (Scopoli)	D2	D1	D1	D1	D1	D1
Cavariella theobaldi (Gillette et Bragg)	–	–	–	D1	D1	–
Cryptomyzus galeopsidis (Kaltenbach)	–	D1	D1	–	–	–
Dysaphis crataegi (Kaltenbach)	D1	D1	D1	D1	D1	–
Hyalopterus pruni (Geoffroy)	D1	D1	D1	D1	–	–
Hypermyzus lactucae (Linnaeus)	–	–	–	–	D1	–
Hypermyzus pallidus Hille Ris Lambers	D1	D1	D1	–	D1	–
Macrosiphum euphorbiae (Thomas)	D1	D2	D1	–	–	–
Macrosiphum rosae (Linnaeus)	–	–	–	–	D1	–
Megoura viciae Bucton	D1	–	–	–	–	–
Metopolophium dirhodum (Walter)	D1	D1	D1	–	D1	–
Microlophium evansi (Theobald)	–	–	–	D1	D1	D1
Myzus persicae (Sulzer)	D1	D1	D1	–	D1	–
Nasonovia ribisnigri (Mosley)	D1	D1	D1	–	–	–
Phorodon humuli (Schrank)	D2	D3	D1	D1	–	–
Rhopalosiphum padi (Linnaeus)	D3	D2	D2	D2	D3	D2
Sitobion avenae (Fabricius)	D1	D1	D1	D2	D4	D1
Sitobion fragariae (Walter)	–	–	–	D1	–	–

D4 – dominants; D3 – subdominants; D2 – numerous species; D1 – not numerous species is worth mentioning that the ‘ditch margin’ plants were represented by *A. fabae* host plants, including most frequent *Cirsium arvense* and numerous *Amarantus retroflexus, Arctium lappa* and *Papaver rhoeas*. In the successive year the field was sown with maize (*Zea mays*) which is also a host plant of that aphid. In 1996 triticale (*Triticosecale rimpaui*) was cultivated in the field and here black bean aphid was also dominant. The ‘ditch margin’ plants included: *Rumex crispus, Polygonum persicaria, Cirsium arvense* and *Matricaria inodora,* which are host species of the aphid. It seems therefore that *A. fabae* is trophically related with host plants of a wide ecological spectrum (Hałaj and Wojciechowski 1996). A high abundance of one dominant, accompanied by a decreasing number of companion species, points to a severe distortion of the habitat researched (Gębicki et al. 1977). It was also observed that over the two research years in the ’ditch margin‘ *Rhopalosiphum padi* (D3, D4) and *Sitobion avenae* (D3) were numerous (Tab. 2). The aphids are related to grass vegetation and are dangerous cereal pests (Szelęgiewicz 1968). In 1994, abundant aphids infesting cereals, especially *R. padi,* could have been related to a high share of grasses *F. arundinacea, F. rubra, E. repens, P. trivialis* in this habitat (Czylok 1988). The dominance structure of aphid communities on the ‘ditch margin’ is relatively permanent, which is seen by repetitive occurrence of the same species. One can assume, therefore, that communities of these insects are characteristic of the ‘ditch margin’ and are related to it relatively permanently (Klimaszewski et al. 1980; Ruszkowska 1997). In 1994, as have already been mentioned, in the second habitat researched in thickets with trees, a dominance of *A. fabae* must have been linked to a vicinity of the field sown with sugar beet and a considerable infestation of the plants with this aphid. Besides in the herb layer, ‘thickets with trees’ were infested with *C. album, Urtica dioica, Polygonum heterophyllum, M. inodora, Arctium tomentosum* and *Cirsium arvense* – plants infested with black bean aphid and which can serve as its supplement source of food. In 1996, *R. padi* and *S. avenae* (Tab. 2) were dominants (D4) and subdominants (D3) in the same ‘thickets with trees’ when triticale was cultivated in the adjacent field, respectively. In the herb layer – grasses, similarly as in the preceding year, accounted for the highest share. All that indicates that the crop cultivated on the adjacent field showed a decisive effect on the aphid species and their dominance structure in the natural environment adjacent to the field (Bennewicz and Kaczorowski 1997).

Over the two research years the observed similarity of aphid communities in midfield thickets and the adjacent field could have been due to a dominant occurrence of harmful aphid species related to field crop (Figs. 4a, b). The evaluation of the relationship between the habitats researched and the field plantation was based on qualitative and quantitative criteria (Shannon-Weaver Index). Over the two research years there was observed a significantly lower species diversity of the aphid communities related with the field (Figs. 5a, b). All that is linked to a high abundance and dominance of harmful species in the field and, at the same time, to a marginal occurrence of the other aphid species (Kaczorowski and Bennewicz 1995). In 1996 aphid species diversity was significantly higher in ‘thickets with trees’ than in the ‘ditch margin’, which coincides with other reports showing that thickets with trees of field edges are richer in aphid fauna than typical midfield boundaries

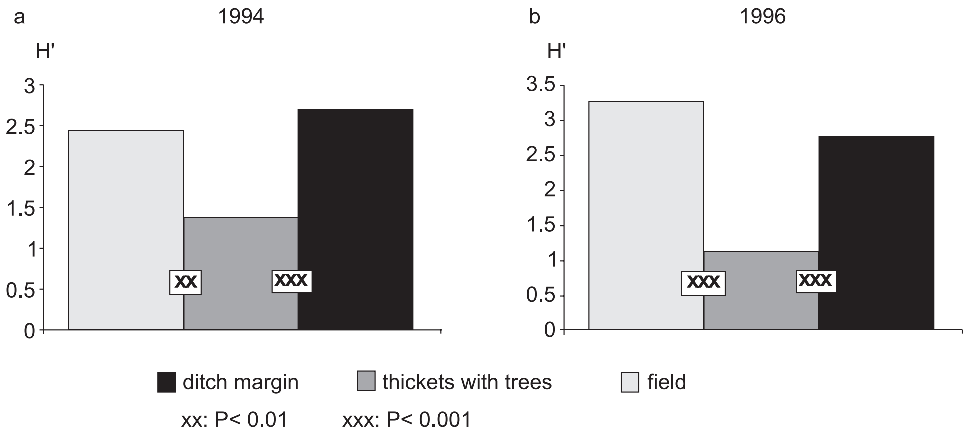

Fig. 4. Diversity of aphids communities in midfield thickets and field

(Bennewicz and Krasicka-Korczyńska 1997; Barczak et al. 2000). Research of Barczak et al. (2000) and Bennewicz et al. (2001) showed that *A. fabae* infested *Arctium minus, A. lappa, Rumex crispus, R. obtusifolius, Cirsium arvense, Matricaria inodora,* and *U. dioica*. Black bean aphid is a species formed from a few subspecies which differ in their host plant spectrum. Only one subspecies, *A. fabae* Scop. sensu stricto is a pest of beet and bean. Summer host plant of *A. fabae solanella* Theob. is *Solanum* L., while *A. fabae cirsiiacanthoidis* Scop. – *Cirsium* L., (Müller 1982). Similarly *Rumex obtusifolius* is infested only with a non-harmful subspecies *A. fabae solanella* Theob. Besides the reports of Müller (1982) show that *Arctium minus* and *M. dicoidea* were willingly infested both with *A. cirsiiacanthoidis* and with *A. fabae* sensu stricto, while Winiarska (1997) states that *Arctium* L. can be infested with *A. fabae cirsiiacanthoidis* and *A. fabae solanella*. Based on the above literature reports, one can say that natural environments in which black bean aphid is observed can not be unanimously treated as reservoirs of this pest for the field's crop (Bennewicz 1996; Bennewicz and Krasicka-Korczyńska 1997; Bennewicz and Kaczorowski 1999; Bennewicz et al. 2001). The reports of Barczak et al. (2000) show that the plants

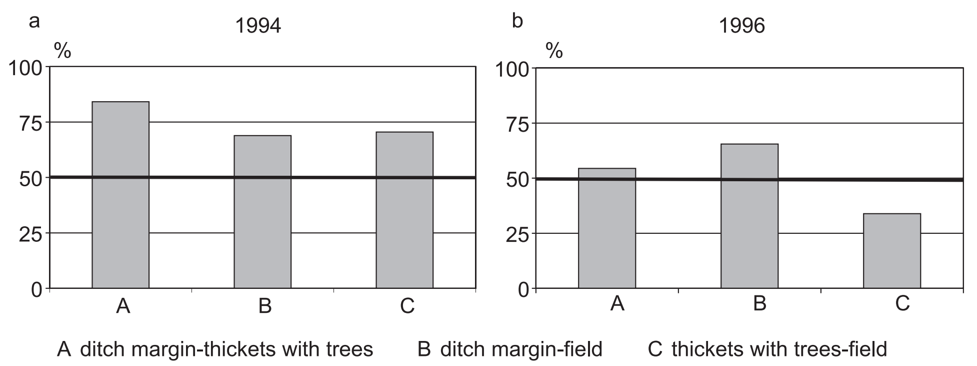

Fig. 5. Similarity of dominance structure between aphid communities

tested were not observed to be infested with three most important cereal aphid species (*S. avenae*, *R. padi* and *Metopolophium dirhodum*). Neither there was observed wild-growing plants being infested with these species in different midfield thickets on the territory of the Kujawy-and-Pomorze Province (Bennewicz 2001; Bennewicz et al. 2001). On the other hand, Ruszkowska (1997) observed the occurrence of all the three aphid species in winter crops in late autumn. All that suggests that these aphids infest more willingly winter crops than wild-growing plants in the adjacent thickets. The present research and reports of Puszkar et al. (1998) and Barczak et al. (2000) showed that the vegetation of midfield thickets with trees and roadside does not, as a rule, create crop pest reservoirs, places of feeding and reproduction that would, as a consequence, pose a threat for the adjacent field crop. Puszkar et al. (1998) suggest, however, that aphids can pose a threat. One should, in their opinion, cut down bushes such as *Euonymus* L., *Viburnum* L., *Rhamnus* L. *Philadelphus* L. or *Padus* L., as aphid winter host plants in order to restrict the occurrence of these pests. English reports, however, showed that cutting down spindle trees did not restrict black bean aphid spreading effectively (Way and Cammell 1982). The above show that evaluating midfield thickets is not unanimous; one shall consider the fact that these semi-natural environments are also a shelter and feeding place for numerous beneficial organisms, including aphid natural enemies (Kaczorowski and Bennewicz 1995; Bennewicz and Kaczorowski 1997; Barczak et al. 2000).

CONCLUSIONS

1. The investigated semi-natural environments should not constitute a phytosanitary threat as the dominating aphid species, including *A. fabae, R. padi* and *S. avenae* were observed earlier and sometimes longer in the adjacent field. Therefore the crop must have offered a much more attractive source of food, both quantitatively- and qualitatively, than the plants of the adjacent habitat.
2. The environments evaluated, including boundaries with a dominant herb layer, can play a role as ecological corridors in the spread of aphids to agrocenoses as they make it possible in autumn – either overwintering, e.g.: *S. avenae* or, after a seasonal stay, flying onto winter host plants, e.g. *R. padi*.

REFERENCES

Barczak T. 1992. Functional response of the tritrophic system *Aphis fabae* Scop. – primary parasitoids – hyperparasitoids of different types of habitat. Preliminary results. Pol. Pismo Entomol., 61 (1): 19–124.

Barczak T., Kaczorowski G., Bennewicz J., Krasicka-Korczyńska E. 2000. Znaczenie zarośli śródpolnych jako rezerwuarów naturalnych wrogów mszyc. Wyd. Uczeln. ATR, Bydgoszcz, 47 pp.

Bennewicz J. 1996. Incidence of aphids in boundary and adjacent sugar beet field. Aphids and Other Homopterous Insects 5: 23–31.

Bennewicz J. 2001. Zgrupowania mszyc i ich naturalnych wrogów, muchówek z rodziny bzygowatych w zaroślach śródpolnych. Prog. Plant Protection/Post. Ochr. Roślin 41 (2): 670–674.

Bennewicz J., Kaczorowski G. 1997. Miedza – zagrożenie czy korzyść dla plantacji buraka cukrowego. Biul. IHAR 202: 225–227.

Bennewicz J., Kaczorowski G. 1999. Mszyce (*Aphidodea*) i biegaczowate (*Carabidae*) zakrzewień śródpolnych. Prog. Plant Protection/Post. Ochr. Roślin 39 (2): 603–607.

Bennewicz J., Krasicka-Korczyńska E. 1997. Zgrupowania mszyc a różnorodność roślinności zarośli śródpolnych pól uprawnych. Prog. Plant Protection/Post. Ochr. Roślin 37 (2): 88–92.

Bennewicz J., Kaczorowski G., Barczak T. 2001. Aphids in midfield thickets in Lower Vistula Valley Landscape Park. J. Plant Protection Res., 41 (4): 348–362.

Boczek J. 1992. Niechemiczne metody zwalczania szkodników roślin. SGGW, Warszawa, 243 pp.

Czylok A. 1988. Zbiorowiska naturalne jako rezerwuar mszycy zbożowej (*Sitobion avenae, Aphidodea, Homoptera*) na przykładzie badań w Niecce Nidziańskiej. Zesz. Probl. Post. Nauk Rol., 353: 7–13.

Gabriel W., Nuckowski S., Wislocka M. 1964. Badania nad mszycami na plantacjach ziemniaka. Pol. Pismo Entomol., 4: 35–56.

Gębicki C., Głowacka E., Karwańska J., Klimaszewski M., Wojciechowski W. 1977. Zgrupowania piewików, mszyc i koliszków (*Homoptera*: *Auchenorrhyncha*, *Aphidodea* i *Psyllodea*) wybranych środowisk rejonu huty „Katowice". Acta Biol., 4 (189): 95–122.

Hałaj R., Wojciechowski W. 1996. Zgrupowania mszyc (*Homoptera*, *Aphidinae*) związane ze zbiorowiskami murawowymi z klasy *Festuco-Brometea* i *Sedo-Scleranthetea* Wyżyny Częstochowskiej. Acta Biol., 29 (46): 83–105.

Hutcheson K. 1970. A test for comparing diversities based on the Shannon formula. J. Theor. Biol., 29: 151–154.

Kaczorowski G., Bennewicz J. 1995. Siedliska brzegowe jako element ochrony plantacji buraka cukrowego przed szkodnikami. Materiały 35. Sesji Nauk. Inst. Ochr. Roślin, cz.2: 403–407.

Klimaszewski M., Wojciechowski W., Czylok A., Gębicki C., Herczek A., Jasińska J. 1980. Zgrupowania wybranych grup pluskwiaków równoskrzydłych (*Homoptera*) i różnoskrzydłych (*Heteroptera*) w lasach rejonu huty „Katowice". Acta Biol., 8: 22–39.

Kondracki J. 2000. Geografia regionalna Polski. PWN, Warszawa, 441 pp.

Lagerlöf J., Wallin H. 1988. Cropping systems, field margins and invertebrate fauna in Swedish agriculture. Bull. INTECOL 16: 55–59.

Matuszkiewicz W. 2001. Przewodnik do oznaczania zbiorowisk roślinnych Polski. PWN. Warszawa, 537 pp.

Matuszkiewicz W., Faliński J.B., Kostrowicki A.S., Matuszkiewicz J.M., Olaczek R., Wojterski T. 1995. Potencjalna roślinność naturalna Polski – mapa przeglądowa 1: 300 000. PAN, Instytut Geografii i Przestrzennego Zagospodarowania.

Müller F. P. 1982. Das Problem *Aphis fabae*. Z. Ang. Entomol., 94: 432–446.

Opyrchalowa J., Goos M. 1973. Dynamika nalotów mszycy trzmielinowo-burakowej *Aphis fabae* Scop. na buraki. Biul. Inst. Ochr. Roślin 56: 233–247.

Pawlikowski T. 1985. Zgrupowania dzikich pszczołowatych (*Hymenoptera*, *Apoidea*) w kserotermicznych siedliskach wydmowych Kotliny Toruńskiej. Stud. Soc. Sci. Torunensis E., 10: 3–57.

Pawłowski B. 1972. Skład i budowa zbiorowisk roślinnych oraz metody ich badań. p. 137–268. In „Szata roślinna Polski" (W. Szafer, K. Zarzycki, eds.). PWN, Warszawa.

Puszkar L., Puszkar T., Michalska Z. 1998. Problemy przechowalnictwa szkodliwych gospodarczo organizmów w zadrzewieniach. p. 293–305. In „Ekologia wysp leśnych" (J. Banaszak, ed.). Wyd. Uczeln. WSP, Bydgoszcz.

Ruszkowska M. 1997. Jesienne populacje mszyc na oziminach w Wielkopolsce w roku 1996. Prog. Plant Protection/Post. Ochr. Roślin 37 (2): 93–95.

Rutkowski L. 1998. Klucz do oznaczania roślin naczyniowych Polski Niżowej. PWN, Warszawa, 812 pp.

Szelęgiewicz H. 1968. Mszyce – *Aphidodea*. 21(4). In „Katalog fauny Polski". PWN, Warszawa, 316 pp.

Way M.J., Cammell M.E. 1982. The distribution and abundance of the spindle tree, *Euonymus europaeus*, in Southern England with particular reference to forecasting infestations of the black been aphid, *Aphis fabae*. J. Appl. Ecol., 19: 929–940.

Winiarska W. 1997. Wrogowie naturalni mszycy kompleksu *Aphis fabae* Scop. (*Aphididae*) na wybranych gatunkach chwastów terenów zieleni miejskiej Lublina. Wyd. AR, Lublin, 80 pp.

Witkowski Z. 1970. Zagadnienia różnorodności gatunkowej w badaniach biocenotycznych. Wiad. Ekol., 16: 117–132.

Wojciechowski W., Czylok A. 1990. *Aphidodea*. p. 106–118. In, „Wykaz zwierząt Polski" (W.J. Razowski, ed.).Wyd. Nauk. PAN, Vol. I.

POLISH SUMMARY

ZNACZENIE ZAROŚLI ŚRÓDPOLNYCH W ROZPRZESTRZENIANIU SIĘ MSZYC

W latach 1994 i 1996 na terenie województwa kujawsko-pomorskiego w regionie wybitnie rolniczym, we wsi Leszcz przeprowadzono badania nad występowaniem mszyc (*Aphidodea*) w zaroślach śródpolnych. Celem pracy było określenie roli mszyc w opanowywaniu przyległych pól oraz ustalenie powiązań między tymi środowiskami a przyległymi uprawami.

Mszyce odławiano do pułapek Moericke'go ustawionych na wysokości wierzchołków roślin zielnych. Owady wybierano z pułapek co 10 dni. Na każdej powierzchni badawczej umieszczono po trzy pułapki w odległości 10 m od siebie. Przeprowadzono ocenę faunistyczno-ekologiczna zebranego materiału.

Powierzchniami badawczymi były – „pobrzeże rowu", które porastała prawie wyłącznie roślinność zielna, wśród której dominowały trawy tworzące zbiorowisko *Potentillo-Festucetum arundinaceae*; – „zadrzewienia" głównym komponentem były tutaj drzewa i krzewy z *Querco-Fagetea*, najliczniej występował *Quercus robur*, pod okapem drzew i krzewów najliczniej występowały trawy. Szata roślinna obydwu badanych powierzchni podlegała silnym wpływom intensywnej gospodarki rolnej prowadzonej na przyległych polach uprawnych. Na przyległym polu do omawianych siedlisk uprawiano w1994 roku burak cukrowy, a w 1996 pszenżyto.

W obu latach badań na polu liczniej odławiano mszyce niż w obu przyległych do niego siedliskach półnaturalnych, przyczyniła się do tego głównie dominacja mszycy burakowej *Aphis fabae* Scop. Struktura dominacji zgrupowań mszyc na „pobrzeżu rowu" była stosunkowo trwała, o czym świadczy liczne występowania tych samych gatunków, takich jak *A. fabae*, *Rhopalosiphum padi* i *Sitobion avenae*. Można przypuszczać, że zgrupowania tych owadów są charakterystyczne dla „pobrzeża rowu" i są z nim stosunkowo trwale związane. W roku 1994, w drugim z badanych siedlisk w „zadrzewieniach", dominowała *A. fabae*. Przyczyniła się do tego zapewne bliskość pola z zasiewami buraka cukrowego i dużym opanowaniem roślin tego gatunku przez tę mszycę. Ponadto, w warstwie roślinności zielnej występowały rośliny zasiedlane przez mszycę burakową i mogące stanowić jej zastępcze źródło pokarmu. W kolejnym roku badań (1996) w tych samych „zadrzewieniach", kiedy na przyległym polu uprawiano pszenżyto, współdominowały *R. padi* i *S. avenae*. W warstwie roślinności zielnej – trawy, podobnie jak w 1994 roku, miały największy udział. Świadczy to, że uprawiana roślina na przyległym polu miała decydujący wpływ na występujące gatunki mszyc i ich strukturę

dominacji w środowisku naturalnym graniczącym z polem oraz stanowiła znacznie atrakcyjniejszą bazę pokarmową, zarówno pod względem ilościowym, jak i jakościowym. Ponadto, badane środowiska półnaturalne nie powinny stanowić zagrożenia fitosanitarnego, ponieważ dominujące tutaj gatunki mszyc obserwowano wcześniej i niejednokrotnie dłużej na przyległym polu. Jedynie miedze z dominującą roślinnością zielną, mogą odgrywać pewną rolę, jako korytarze ekologiczne w rozprzestrzenianiu się mszyc do agrocenoz. Umożliwiając mszycom zimowanie, albo okresowy ich pobyt, przed przelotem na żywicieli zimowych.