

FRAGMENTA FAUNISTICA

Fragm. faun.	Warszawa, 31.12.2002	45	163-167
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Studies on the occurrence frequency of insects and mites causing galls on leaves of hornbeam *Carpinus betulus* L. in southern Poland¹

Abstract: Studies on the species composition of galls occurring on the leaves of *Carpinus betulus* L. were conducted in 2001 in the following three localities: the Wolski Forest, the Ojców National Park and the Krzeszowice Forest District (UTM-DA-16). A total of 1852 galls were found. The galls were caused by insect or mite species. *Aceria macrotricha* (NALEPA, 1919) was the most abundant species. The index of occurrence frequency and the Agrell index of species association have been calculated..

Key words: *Diptera*, *Acarina*, plant-galls, *Carpinus betulus*

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INTRODUCTION

Hornbeam *Carpinus betulus* L. is a valuable component of our forest stands. On its leaves the galls may be found, often caused by *Zygiobia carpini* (F. LÖW, 1874) (*Diptera*, *Cecidomyiidae*) (BUHR 1964-1965, SKUHRAVÁ 1994, POSTNER 1982, CSÖKA 1997). According to SKUHRAVÝ & SKUHRAVÁ (1998) *Z. carpini* occurs more abundantly in the warmer localities. *Aceria macrotricha* (NALEPA 1919) (*Acarina*, *Eriophyidae*) is found comparatively rarely. SKRZYPCZYŃSKA (1997) reported on the index of occurrence frequency of galls on leaves of hornbeam growing in the Ojców National Park in southern Poland during two consecutive years. However, no comparison was made between the frequencies of the gall - makers on *Carpinus betulus* growing under

¹ Part of this investigations is under the problem 5PO6H 08819 sponsored by the State Committee for Scientific Research

different site condition in stands of different function in a single vegetation season. For this reason a study was undertaken the aim of which was:

- to compare the species composition of gall-makers on hornbeam foliage in stands situated near an urban agglomeration, in a protected area, and in a managed forest,
- to evaluate the frequency of their occurrence,
- to determine the species associations.

MATERIAL AND METHODS

The field studies were carried out in 2001 in three localities: in the upland forest of the Wolski Forest situated near Kraków, in the mixed upland forest of the Ojców National Park, and in the upland forest, a part of Dolina Będkowska Forest Range of the Krzeszowice Forest District (the Kraków Forest Region) (UTM DA 16).

These localities were chosen because of their situation, namely – near an urban agglomeration of Kraków (the Wolski Forest), in a protected area (the Ojców National Park), and in a management forest (the Krzeszowice FD). In each locality, 20 trees of *Carpinus betulus* were selected at random. From each tree 100 leaves were randomly collected, in total 6000 leaves were tested. The galls were identified using BUHR'S work (1964–1965). The following publications were also used: NUNBERG (1964), SCHNAIDER (1976) SKUHRAVÁ & SKUHRAVÝ (1992), as well as SKUHRAVÝ & SKUHRAVÁ (1998).

In order to calculate the frequency of gall occurrence, the formula given by SEGEBADE & SCHAEFER 1979) was used:

$$F = \frac{z}{n} ad$$

where: n – number of trees, z – number of trees with galls, a – a participation of attacked leaves in relation to all analysed leaves, d – mean number of galls per leaf attacked.

To describe the degree of association among species found, the Agrell index of species association was calculated.

RESULTS

A total of 1852 galls, caused by 4 insect and mite species, were found on *Carpinus betulus* leaves. Out of this number, 1105 galls were identified in the Ojców NP., and the lowest number i.e. 78 galls – in the Wolski Forest (Table I). *Aceria macrotricha* (Acarina, Eriophyidae) was the most abundant species with 1037 galls found in the Ojców NP. The same species was also numerous, with 430 galls identified, in the Krzeszowice FD (Table I). Among gall – midges (Diptera, Cecidomyiidae) the most abundant species was *Contarinia carpini* KIEFFER, 1897, with 201 galls found in the Krzeszowice FD and 69 galls – in the Wolski Forest. *C. carpini* was not present in the Ojców NP. There were also other species encountered, as follows: *Aschistonyx carpinicolus* RÜBSAAMEN, 1917 and *Zygiobia carpini* (F. LÖW, 1874) (Diptera, Cecidomyiidae).

Table I. Occurrence frequency (F) for galls on the leaves of *Carpinus betulus* L. in the Wolski Forest (LW), the Ojców National Park (OPN) and the Krzeszowice Forest District (NK) in 2001 (*- per total number of 20 analysed trees, ** - per total number of 2000 analysed leaves).

Species	Number of trees with galls*			Number of leaves with galls**			Number of galls on analysed leaves			F		
	LW	OPN	NK	LW	OPN	NK	LW	OPN	NK	LW	OPN	NK
<i>Acarina, Eriophyidae</i>												
<i>Aceria macrotricha</i> (NALEPA, 1919)	1	2	1	2	146	62	2	1037	430	0.00005	0.0518	0.0107
<i>Diptera, Cecidomyiidae</i>												
<i>Aschistonyx carpinicolus</i> RÜBSAAMEN, 1917	3	2	8	5	4	9	5	4	9	0.00030	0.0002	0.0018
<i>Contarinia carpini</i> KIEFFER, 1897	19	-	20	69	-	194	69	-	201	0.00327	-	0.1005
<i>Zygiobia carpini</i> (F. LÖW, 1874)	2	18	6	2	28	14	2	64	29	0.00010	0.0288	0.0043

The mean number of galls per leaf attacked was the highest in the case of *A. macrotricha* (7.10 galls in the Ojców NP). The lowest value of this index was 1.0, and this concerned *A. macrotricha* (the Wolski Forest), *A. carpinicolus* (the Wolski Forest, the Ojców NP.), and *Z. carpini* (the Wolski Forest).

The index of occurrence frequency (F) was highest in the case of *Contarinia carpini*, namely 0.1005 (the Krzeszowice FD), while it was lowest for *Aceria macrotricha* - 0.00005 in the Wolski Forest. This means that *C. carpini* was over 2000 times more frequent than *A. macrotricha*. The most considerable difference in this index occurred in the case of *A. macrotricha*; it was 1036 times higher in the Ojców NP than in the Wolski Forest.

This index considerably varied in the case of *Zygiobia carpini*; it was 288 times higher in the Ojców NP than in the Wolski Forest. The index of occurrence frequency for the remaining species is given in Table I.

The Agrell index of species association (A_g) reached the highest value, i.e. 0.400, for *Contarinia carpini* and *Aschistonyx carpinicolus* - in the Krzeszowice FD (Table II).

Table II. The Agrell index of species association (A_g) in relation to the causing galls on *Carpinus betulus* L. leaves in the Krzeszowice Forest District in 2001.

	Species	1	2	3	4
1	<i>Aceria macrotricha</i>	-	-	0.050	-
2	<i>Aschistonyx carpinicolus</i>	-	-	0.400	0.166
3	<i>Contarinia carpini</i>	0.050	0.400	-	0.300
4	<i>Zygiobia carpini</i>	-	0.166	0.300	-

High values of this index were also reached by *A. carpinicolus* and *A. macrotricha* in the Wolski Forest and the Ojców NP, i.e. to 0.333 (Tables III and IV). The Agrell index had its lowest value, namely 0.050 in the case of *Zygiobia carpini* and *Contarinia carpini* - in the Wolski Forest, as well as *C. carpini* and *A. macrotricha* - in the Krzeszowice FD (Tables III and III). The lowest value of this index (0.050) was

8 times lower than in its highest value (0.400). The Agrell index for the remaining species is given in the Tables II, III and IV.

Table III. The Agrell index of species association (Ag) in relation to the causing galls on *Carpinus betulus* L. leaves in the Wolski Forest in 2001.

	Species	1	2	3	4
1	<i>Acrisia macrotricha</i>	-	0.333	-	-
2	<i>Asdistonyx carpnicolus</i>	0.333	-	0.157	-
3	<i>Cortarinia carpini</i>	-	0.157	-	0.050
4	<i>Zygiobia carpini</i>	-	-	0.050	-

Table IV. The Agrell index of species association (Ag) in relation to the causing galls on *Carpinus betulus* L. leaves in the Ojców National Park in 2001.

	Species	1	2	3
1	<i>Acrisia macrotricha</i>	-	0.333	0.052
2	<i>Asdistonyx carpnicolus</i>	0.333	-	0.052
3	<i>Zygiobia carpini</i>	0.052	0.052	-

CONCLUSIONS

1. Location of hornbeam – near an urban agglomeration, in a national park, and in a managed forest has no significant influence on the species composition of gall-makers on *Carpinus betulus* leaves.
2. The frequency of galls occurrence varied considerably in the investigated localities.
3. Associations of gall-maker species varied distinctly in different sites.

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[Tytuł: Badania częstości występowania owadów i pajęczaków powodujących wyrośla na liściach grabu pospolitego *Carpinus betulus* L. w południowej Polsce]

Badania wyrośli na liściach grabu pospolitego *Carpinus betulus* L. prowadzono w 2001 roku na trzech stanowiskach. Pierwsze – Las Wolski usytuowane było w pobliżu aglomeracji miejskiej Krakowa, drugie na obszarze prawnie chronionym w Ojcowskim Parku Narodowym a trzecie w drzewostanie gospodarczym w Nadl. Krzeszowice, Leśn. Dolina Będkowska. Na każdym stanowisku, z 20 wybranych losowo grabów pobrano po 100 liści.

W wyniku badań stwierdzono 1852 wyrośla, w tym najwięcej – 1105 w materiale z Ojcowskiego Parku Narodowego. Wyrośla były spowodowane przez cztery gatunki sprawców: *Aceria macrotricha* (Acarina, Eriophyidae), *Aschistonox carpnicolus*, *Contarinia carpini*, *Zygiobia carpini* (Diptera, Cecidomyiidae). Najliczniej w badanym materiale występował gatunek *Aceria macrotricha*, który spowodował 94% wyrośli na stanowisku w Ojcowskim Parku Narodowym i 64% w Nadl. Krzeszowice. Wskaźnik częstości występowania wyrośli najwyższą wartość (0,1) osiągnął dla gatunku *Contarinia carpini*, który był sprawcą 88% wyrośli na stanowisku w Lesie Wolskim.