

GALL-INDUCING ARTHROPODS ASSOCIATED WITH ORNAMENTAL WOODY PLANTS IN A CITY PARK OF NITRA (SW SLOVAKIA)

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Abstract

The research was carried out in Slovakia from 2004-2008, in a city park area in Nitra. The research was oriented to gall-forming insects and mites on ornamental woody plants in an urban environment. A visual control of woody plants in the terrain was done, and an individual species was determined according mainly to collected samples of symptoms. In total 122 species of gall-forming insect and mites species were identified and recorded, specifically, 91 species of insects and 31 species of mites (Eriophyidae, Phytoptidae). Thirteen alien insects were also found during the research. The most frequented host plants for gall-inducing organisms were genera *Quercus* (28 species), *Acer* (10 species), *Salix* (10 species), *Populus* (9 species) and *Tilia* (8 species).

KEY WORDS: gall-forming arthropods, alien species, urban area, Lepidoptera, Acari, Diptera, Hemiptera, Coleoptera, Hymenoptera

Introduction

Aesthetic aspects are also highlighted in the park planting and the condition of the urban greenery. Due to damage, the woody plant loses its original habitus and the coloration of its original leaves, and some necrosis occurs (KELBEL & SUVÁK, 2008). The feeding of some pest species causes damage to various plant tissues, which does not necessarily lead to woody plant dieback but does cause aesthetic damage. Various gall-forming species also belong to this group of pests (GREGOROVÁ, 2006). The biology of these species is often poorly explored. Species identification and knowledge of the diversity of gall-forming pests are important for the protection and commercial growing of woody plants, urban and private gardens. Global climate changes affect environmental conditions and have created a base for an increase in gall-forming pests (KELBEL, 2009). (STONE & SCHÖNRÖGGE 2003) mentioned about 13 000 species of different insects groups which cause galls

on plants. NIENHAUS & KIEWNICK (1998) characterize the galls as anomalies on plant organ parts (organoid gall) or in tissue parts (histoid gall), which are created during the activity of gall-forming insects. CSÓKA (1997) characterizes gall (cecidium) as an abnormal growth on a part of a plant where the number and/or the size of cells is increased relative to the normal state due to the activity of another organism (virus, nematode, arthropod etc.). Leuwenhoek (1632 - 1723) and Malpighi (1628 - 1694) were the first to identify gall formation as the result of oviposition by an insect (CSÓKA, 1997). The term cecidium was introduced into scientific literature in 1873 for the first time by Austrian entomologist F.A.W. Thomas (SKUHRAVÝ & SKUHRAVÁ, 1998). The greatest variety of galls, which can be observed on shoots, needles, leaves and buds, is caused by numerous insect species from the Cecidomyiidae and Cynipidae families (HRUBÍK, 1988). CSÓKA (1997) presents 7 insect orders which create galls. The greatest number of gall-forming species belongs to the Diptera and Hymenoptera orders. Many gall-forming species also belong to the Homoptera and Thysanoptera orders.

From dipterous, the gall midges (Cecidomyiidae, Diptera) induce the most number of galls on plants. Most gall midge species are monophagous and their larvae develop on one plant species only. Few gall midges are oligophagous and their larvae may develop on two, three or more species on the genus of the host plant. Some species are polyphagous and may develop on many species and genera (SKUHRAVÁ *et al.*, 2007). They are small flies a few mm in size. The majority of larvae induces different anomalies on the leaves where they develop and suck juice (GOGOLA, 1985). These anomalies allow for easy determination of species of midges. However, midges which live on plants but do not induce galls (in cones and seeds of woody plants) also exist. Furthermore, midges which develop in galls of other species do not induce the galls. Phytophagous species represent about 76 % of all midge species (KŘÍSTEK & URBAN, 2004). In Slovakia 362 midge species (SKUHRAVÁ, 2005) were recorded. Several authors (SKUHRAVÁ & SKUHRAVÁ, 1986, SKUHRAVÝ *et al.* 1992, HRUBÍK 1988, HRUBÍK, *et al.*, 1998, HRUBÍK, 1999, HRUBÍK 2007), whose scientific activities were oriented especially towards the dendrological object Mlynský arboretum SAS dealt with this group of insects.

Aphids (*Homoptera*) damage plants by sucking their juice (VESER, 2001) which causes a decrease in wood growth. The aphids also limit the assimilation process by covering leaves and needles with honeydew. Indirect damage caused by the transportation of viral diseases is very significant. Many species which induce galls belong mainly to the Adelgidae family. Various deformations of leaves are caused by the Aphididae family species (GOGOLA, 1985). Aphids are separated into two groups: 1. Monocyclic – living on one host; and 2. Dicyclic – living on two or more hosts (KŘÍSTEK & URBAN, 2004). In Slovakia many authors (BARTA, 2009, BARTA & CAGÁŇ, 2006a, 2006b, HRUBÍK & JUHÁSOVÁ 1997, HRUBÍK, 1998, KOBZA, 2003, MALINA, PRASLIČKA 2008, BARTEKOVÁ & PRASLIČKA, 2004) have dealt with this group of pests.

Mites (Acari) are not insects; rather, they are classified as arachnoids. The majority of the species has four limb pairs. Many of them feed on dead organic compounds. Some mites suck other mites or insects. The gall-forming mites which are relatively widespread but small, irritate plant tissues and induce galls through their sucking (VESER, 2001). CSÓKA (1997) mentioned 500 species of mites which cause galls (VESER, 2001). CSÓKA (1997) mentioned 500 species of mites which cause galls.

The gall wasps (*Cynipidae*, *Hymenoptera*) are the most numerous family which causes various galls. From all woody plant species, the oaks (*Quercus* sp.) are the most harmed by gall wasps, where gall formation was observed on various plant organs (KELBEL, 2006). PFEFFER *et al.* (1961) presents ca 100 gall wasp species, which develop in oak galls. KELBEL (2001, 2002, 2004), KELBEL & HLAVÁČ (2004) dealt with the detailed bionomy of these group in Slovakia

Less significant orders which induce galls on plant organs belong to the *Coleoptera* (beetles) and *Lepidoptera* (butterflies) orders. From the beetles, some longhorn beetles (*Cerymbycidae*) induce swellings on shoots, or leaf-rolling weevils (*Attelabidae*) curl the leaves into various forms. From the butterflies, tortrix moths (*Tortricidae*) cause different deformations and galls mainly on coniferous woody plants.

Material and Methods

The research was carried out in a city park in Nitra from 2004 to 2008. The research was oriented towards gall-forming insects and gall mites pests which feed on ornamental trees and shrubs in an urban environment. The city park in Nitra is situated in the north-western part of the city and lies 140 m above sea level. The park, which covers 20 ha, has three parts: Sihot', New Park and Connecting Park. The park is bordered by the Nitra River. In the park are woody plants in various age groups. The city of Nitra is situated on the west side of the Slovak Republic, on 48° N 14' E.

The climate is characterized as semi-arid and humid. The average annual total precipitation is about 600 mm. The average annual temperature is about 9.5 °C.

During the growth season, the gall-forming species were monitored weekly in field conditions. Woody plants were checked visually; individual species were determined mainly according to collected samples of symptoms. Some species were determined immediately in the field. Available literature: CSÓKA (1997), SCHNAIDER (1976), SKUHRAVÝ & SKUHRAVÁ (1998), BLACKMAN & EASTOP (1994) was used to determine gall causers on woody plants. The correct terminology for woody plants was taken from a publication by MARHOLD & HINDÁK (1998). For taxonomic classification and correct terminology of gall-forming organisms the zoological database Fauna Europaea (<http://www.faunaeur.org>) was used.

Results and Discussion

During the research in the park in Nitra, 122 species of gall-forming insects and mites were found on woody plants generally. Tab. I presents all insect and mites species found and their host woody plants.

Table I. List of gall-forming species found in Nitra city Park.

Order/Family/Species	Host plant	Symptom
Acarina		
Eryophyidae		
<i>Aceria macrorrhynchus</i> Nal., 1889	<i>Acer pseudoplatanus</i> L., <i>A. campestre</i> L., <i>A. monspessulanum</i> L.	leaf gall
<i>Aceria macrochelus</i> Nal., 1891	<i>Acer campestre</i> L.	leaf gall
<i>Aceria pseudoplatani</i> (Corti, 1905)	<i>Acer pseudoplatanus</i> L.	leaf gall
<i>Aceria cephalonea</i> (Nalepa, 1922)	<i>Acer pseudoplatanus</i> L., <i>A. campestre</i> L.	leaf gall
<i>Aceria pyracanthi</i> (Canestrini, 1890)	<i>Pyracantha coccinea</i> Roem.	leaf gall
<i>Aceria tenellus</i> (Nal., 1892)	<i>Carpinus betulus</i> L.	leaf gall

Order/Family/Species	Host plant	Symptom
Eryophyidae		(Table I – continued)
<i>Aceria tristriata</i> (Nal., 1890)	<i>Juglans regia</i> L.	leaf gall
<i>Aceria erinea</i> (Nal., 1891)	<i>Juglans regia</i> L.	leaf gall
<i>Aceria heteronyx</i> (Nalepa, 1891)	<i>Acer pseudoplatanus</i> L.	bark gall
<i>Aceria populi</i> Nal., 1890	<i>Populus alba</i> L.	bud gall
<i>Aceria brevitorsa</i> (Kiefer, 1939)	<i>Alnus glutinosa</i> (L.) Gaertn.	leaf gall
<i>Aceria platanoideus</i> (Roivainen, 1947)	<i>Acer platanoideus</i> L.	leaf gall
<i>Eriophyes padi</i> Domes, 2000	<i>Prunus avium</i> L., <i>P. padus</i> L.	leaf gall
<i>Aculops macrotrichus</i> (Nalepa, 1889)	<i>Carpinus betulus</i> L.	leaf gall
<i>Phyllocoptes goniothorax</i> Nal., 1889	<i>Crataegus monogyna</i> Jacq.	leaf gall
<i>Stenacis euonymi</i> (Frauenfeld, 1865)	<i>Euonymus europaeus</i> L.	leaf gall
<i>Aceria fraxinivora</i> Nal., 1909	<i>Fraxinus excelsior</i> L., <i>F. ornus</i> L.	Gall on buds, twigs and leaves
<i>Aculus craspedobius</i> (Nalepa, 1925)	<i>Salix alba</i> L.	leaf gall
<i>Aculus laevis</i> (Nalepa, 1892)	<i>Salix alba</i> L.	leaf gall
<i>Colomerus vitis</i> (Pagenstecher, 1857)	<i>Vitis vinifera</i> L.	leaf gall
<i>Stenacis triradiatus</i> Nal., 1892	<i>Salix alba</i> L.	flower gall
<i>Eriophyes tiliae</i> (Pagenstecher, 1857)	<i>Tilia cordata</i> Mill., <i>T. platyphyllos</i> Scop.	leaf gall
<i>Eriophyes leiosoma</i> Nalepa, 1892	<i>Tilia cordata</i> Mill., <i>Tilia platyphyllos</i> Scop.	leaf gall
<i>Eriophyes exilis</i> (Nalepa, 1892)	<i>Tilia platyphyllos</i> Scop., <i>T. cordata</i> Mill.	leaf gall
<i>Eriophyes laevis</i> (Nal., 1889)	<i>Alnus glutinosa</i> (L.) Gaertn	leaf gall
<i>Eriophyes inaequalis</i> Wilson & Oldfield, 1966	<i>Alnus glutinosa</i> (L.) Gaertn, <i>A. incana</i> (L.) Moench	leaf gall
<i>Eptrimerus trilobus</i> (Nal., 1891)	<i>Sambucus nigra</i> L.	leaf gall
<i>Vasates quadripedes</i> Schimer, 1869	<i>Acer saccharinum</i> L.	leaf gall
<i>Cecidophyopsis psilaspis</i> Nal., 1893	<i>Taxus baccata</i> L.	bud gall
Phytoptidae		
<i>Phytoptus tetratrichus</i> Nal., 1891	<i>Tilia platyphyllos</i> Scop., <i>T. cordata</i> Mill.	leaf gall
<i>Phytoptus avellanae</i> Nalepa, 1889	<i>Corylus colurna</i> L.	bud gall
Lepidoptera		
Tortricidae		
<i>Retinia resinella</i> (L., 1758)	<i>Pinus sylvestris</i> L.	bud gall
<i>Rhyacionia buoliana</i> (Den.-Schiff., 1775)	<i>Pinus sylvestris</i> L., <i>P. nigra</i> Arnold, <i>P. contorta</i> Dougl. Et Loud., <i>P. mugo</i> Turra, <i>P. jeffrey</i> Grev. et Balf., <i>P. ponderosa</i> Dougl. E P. et C. Laws	bud gall
Hemiptera		
Psyllidae		
<i>Psylloopsis fraxini</i> (L., 1758)	<i>Fraxinus excelsior</i> L.	leaf gall
<i>Psylla buxi</i> Linnaeus, 1758	<i>Buxus sempervirens</i> L.	leaf gall

Order/Family/Species	Host plant	Symptom
Aphididae		
(Table I – continued)		
<i>Aphis fabae</i> Scop., 1763	<i>Phladelphus coronarius</i> L., <i>Euonymus europaeus</i> L., <i>Robinia pseudoacacia</i> L.	leaf gall
<i>Aphis craccivora</i> Koch., 1854	<i>Robinia pseudoacacia</i> L.	leaf gall
<i>Chaitophorus populicola</i> Thomas, 1878	<i>Populus nigra</i> L.	leaf gall
<i>Aphis viburni</i> Scop., 1763	<i>Viburnum rhytidophyllum</i> Hemsl., <i>V. lantana</i> L., <i>V. opulus</i> L.	leaf gall
<i>Aphis schneideri</i> (Bömer, 1940)	<i>Ribes aureum</i> Pursh	leaf gall
<i>Aphis idaei</i> van der Goot, 1912	<i>Ribes aureum</i> Pursh	leaf gall
<i>Myzus cerasi</i> FBR., 1775	<i>Prunus avium</i> L.	leaf gall
<i>Myzus ligustri</i> Kalt., 1841	<i>Ligustrum vulgare</i> L.	leaf gall
<i>Rhopalomyzus Ionicerae</i> Sieb., 1839	<i>Lonicera xylosteum</i> L.	leaf gall
<i>Hyadaphis tataricae</i> (Aizenberg, 1935)	<i>Lonicera xylosteum</i> L., <i>L. nitida</i> Wils.	leaf gall
<i>Aphis farinosa</i> Gmelin, 1790	<i>Salix alba</i> L.	leaf gall
<i>Myzus persicae</i> (Sulzer, 1776)	<i>Hibiscus syriacus</i> L.	leaf gall
<i>Dysaphis crataegi</i> (Kaltenbach, 1843)	<i>Crataegus monogyna</i> Jacq.	leaf gall
<i>Kaltenbachiella pallida</i> (Haliday, 1838)	<i>Ulmus laevis</i> Pall.	leaf gall
<i>Eriosoma ulmi</i> (Linnaeus, 1758)	<i>Ulmus laevis</i> Pall., <i>Ulmus glabra</i> Huds., <i>Ulmus carpinifolia</i> Gleditsch	leaf gall
<i>Tetraneura ulmi</i> (L., 1758)	<i>Ulmus laevis</i> Pall., <i>Ulmus glabra</i> Huds., <i>Ulmus carpinifolia</i> Gleditsch	leaf gall
<i>Prociphilus bumeliae</i> (Schrank, 1801)	<i>Fraxinus excelsior</i> L.	leaf gall
<i>Pemphigus spirothecae</i> Pass., 1860	<i>Populus nigra</i> L., <i>P. simonii</i> Carr.	petiole gall
<i>Thecabius affinis</i> (Kalt., 1843)	<i>Populus nigra</i> L.	leaf gall
<i>Pemphigus populinigrae</i> (Schrank 1801)	<i>Populus nigra</i> L.	leaf gall
<i>Pemphigus populi</i> Courchet, 1879	<i>Populus nigra</i> L.	leaf gall
<i>Pemphigus bursarius</i> (L., 1758)	<i>Populus nigra</i> L.	petiole gall
<i>Pemphigus borealis</i> Tullgren, 1909	<i>Populus nigra</i> L.	bud gall
Adelgidae		
<i>Adelges laricis</i> Vall., 1836	<i>Larix decidua</i> Mill., <i>Picea abies</i> (L.) Karst.	shoot gall
<i>Sacchiphantes viridis</i> (Ratz., 1843)	<i>Picea abies</i> (L.) Karst., <i>P. pungens</i> Engelm., <i>Picea glauca</i> (Moench) Voss., <i>Larix decidua</i> Mill.	shoot gall
<i>Dreyfusia nordmanniana</i> Eckst., 1890	<i>Abies alba</i> Mill.	shoot gall
<i>Gilleteella cooleyi</i> Gill., 1907	<i>Pseudotsuga menziesii</i> (Mirbel) Franco	shoot gall
<i>Dreyfusia piceae</i> Ratz., 1844	<i>Abies concolor</i> (Gord.) Engelm.	shoot gall
Triozidae		
<i>Trichoermes walkeri</i> Förster, 1848	<i>Rhamnus catharticus</i> L.	leaf gall
Coleoptera		
Cerambicidae		
<i>Saperda populnea</i> (L., 1758)	<i>Populus x canescens</i> (Ait.) J. E. SM.	shoot gall
Hymenoptera		
Tenthredinidae		
<i>Euura amerinae</i> L., 1758	<i>Salix alba</i> L.	shoot gall

Order/Family/Species	Host plant	Symptom
Tenthredinidae		(Table I – continued)
<i>Blennocampa pusilla</i> Klug., 1985	<i>Rosa canina</i> L.	leaf gall
<i>Pontania proxima</i> Lep., 1823	<i>Salix alba</i> L.	leaf gall
<i>Pontania viminalis</i> (L., 1758)	<i>Salix purpurea</i> L.	leaf gall
<i>Pontania vesicator</i> Brem., 1849	<i>Salix alba</i> L.	leaf gall
Cynipidae		
<i>Cynips quercuscalicis</i> (Burgsd., 1783)	<i>Quercus robur</i> L.	fruit gall
<i>Cynips quercusfolii</i> L., 1758	<i>Quercus robur</i> L.	leaf gall
<i>Cynips caputmedusae</i> (Htg., 1843)	<i>Quercus robur</i> L.	fruit gall
<i>Andricus hungaricus</i> Hart., 1843	<i>Quercus robur</i> L.	bud gall
<i>Cynips divisa</i> Htg., 1840	<i>Quercus robur</i> L.	leaf gall
<i>Cynips disticha</i> Htg., 1840	<i>Quercus robur</i> L.	leaf gall
<i>Cynips longiventris</i> Htg., 1840	<i>Quercus robur</i> L.	leaf gall
<i>Andricus glutinosus</i> (Giraud 1859)	<i>Quercus robur</i> L.	bud gall
<i>Trigonaspis megaptera</i> Pnz., 1801	<i>Quercus robur</i> L.	gall on bud and shoot
<i>Andricus inflator</i> Htg., 1840	<i>Quercus robur</i> L.	bud gall
<i>Andricus fecundator</i> Htg., 1840	<i>Quercus robur</i> L.	bud gall
<i>Andricus solitarius</i> (Boyer de Fonscolombe, 1832)	<i>Quercus robur</i> L.	bud gall
<i>Andricus testaceipes</i> Hartig, 1840	<i>Quercus robur</i> L.	shoot gall
<i>Andricus lucidus</i> (Htg., 1843)	<i>Quercus robur</i> L.	fruit gall
<i>Andricus kollari</i> (Htg., 1843)	<i>Quercus robur</i> L.	bud gall
<i>Andricus grossulariae</i> Giraud, 1859	<i>Quercus robur</i> L.	flower gall
<i>Andricus cydoniae</i> (Htg., 1840)	<i>Quercus cerris</i> L.	leaf gall
<i>Andricus anthracina</i> (Curtis, 1838)	<i>Quercus robur</i> L., <i>Q. x turneri</i> Willd.	leaf gall
<i>Andricus mayri</i> (Wachtl, 1881)	<i>Quercus robur</i> L.	fruit gall
<i>Andricus coriarius</i> (Htg., 1843)	<i>Quercus robur</i> L.	bud gall
<i>Andricus conglomeratus</i> (Giraud, 1859)	<i>Quercus robur</i> L.	bud gall
<i>Andricus curvator</i> (Htg., 1840)	<i>Quercus robur</i> L.	gall on leaves and buds
<i>Neuroterus numismalis</i> (Fourcr., 1785)	<i>Quercus robur</i> L.	leaf gall
<i>Neuroterus quercus-baccarum</i> (L., 1758)	<i>Quercus robur</i> L.	galls on leaves and flowers
<i>Neuroterus laevisculus</i> (Scheuch., 1863)	<i>Quercus robur</i> L.	leaf gall
<i>Biorrhiza pallida</i> (Ol., 1791)	<i>Quercus robur</i> L.	galls on roots and buds
<i>Diplolepis rosae</i> (L., 1758)	<i>Rosa canina</i> L., <i>R. multiflora</i> Thunb.	gall on leaf bud
Diptera		
Cecidomyiidae		
<i>Craneiobia corni</i> (Giraud., 1863)	<i>Swida sanguinea</i> (L.) Opiz	leaf gall
<i>Dasineura fraxini</i> Bremi, 1847	<i>Fraxinus excelsior</i> L., <i>Fraxinus omus</i> L.	leaf gall
<i>Dasineura fraxinea</i> Kieffer, 1907	<i>Fraxinus excelsior</i> L.	leaf gall
<i>Dasineura rubella</i> Kieffer, 1896	<i>Acer campestre</i> L.	leaf gall
<i>Drisina glutinosa</i> Giard, 1893	<i>Acer pseudoplatanus</i> L., <i>Acer campestre</i> L., <i>Acer platanoides</i> L.	leaf gall

Order/Family/Species	Host plant	Symptom
Cecidomyiidae		(Table I – continued)
<i>Dasineura kellneri</i> (Henschel, 1875)	<i>Larix decidua</i> Mill.	shoot gall
<i>Dasineura tiliae</i> (Schrank, 1803)	<i>Tilia platyphyllos</i> Scop., <i>T. cordata</i> Mill.	leaf gall
<i>Obolodiplosis robiniae</i> (Haldeman, 1847)	<i>Robinia pseudoacacia</i> L.	leaf gall
<i>Rhabdophaga salicis</i> (Schrank, 1803)	<i>Salix alba</i> L.,	shoot gall
<i>Dasineura acrophila</i> (Winnertz, 1853)	<i>Fraxinus excelsior</i> L.	leaf gall
<i>Dasineura gleditchiae</i> (Osten Sacken, 1866)	<i>Gleditsia triacanthos</i> L.	leaf gall
<i>Thecodiplosis brachyntera</i> (Schwägrichen, 1835)	<i>Pinus sylvestris</i> L.	needle gall
<i>Acericecis vitrina</i> (Kieffer, 1909)	<i>Acer pseudoplatanus</i> L., <i>Acer platanoides</i> L.	leaf gall
<i>Dasineura rosae</i> (Bremi, 1847)	<i>Rosa canina</i> L., <i>R. multiflora</i> Thunb.	leaf gall
<i>Oligotrophus juniperinus</i> (Linnaeus, 1758)	<i>Juniperus communis</i> L.	needle gall
<i>Anisostephus betulinus</i> (Kieffer, 1889)	<i>Betula pendula</i> Ehrh.	leaf gall
<i>Mikiola fagi</i> (Hartig., 1839)	<i>Fagus sylvatica</i> L.	leaf gall
<i>Taxomyia taxi</i> (Inchbald, 1861)	<i>Taxus baccata</i> L.	bud gall
<i>Zygobia carpini</i> (F. Low, 1874)	<i>Carpinus betulus</i> L.	leaf gall
<i>Macrodiplosis pustularis</i> (Bremi, 1847)	<i>Quercus robur</i> L.	leaf gall
<i>Macrodiplosis roboris</i> (Hardy, 1854)	<i>Quercus robur</i> L.	leaf gall
<i>Contarinia tiliarum</i> (Kieffer, 1890)	<i>Tilia platyphyllos</i> Scop., <i>T. cordata</i> Mill.	Gall on petiole, flowers, leaves and shoots
<i>Didymomyia tiliacea</i> (Bremi, 1847)	<i>Tilia platyphyllos</i> Scop.	leaf gall
<i>Monarthropalpus flavus</i> (Schrank, 1776)	<i>Buxus sempervirens</i> L.	leaf gall
<i>Rhabdophaga rosaria</i> (H. Loew, 1850)	<i>Salix alba</i> L.	leaf gall

Of the total number of determined species 94 belonged to insects and 31 to mites (Eriophyidae, Phytoptidae). 31 species belonged to Hemiptera, which is the richest group of gall-inducing insects. 23 species belong to the Aphididae family. The Hymenoptera order was represented by 32 species and Diptera by 25 species. Found in small numbers were species from the Lepidoptera (2) and Coleoptera (1) orders. A detailed presentation of individual orders and families is in Tab. II.

The highest number of oligophagous gall-forming species was identified in terms of their trophic fixation to the host plant. Most of these species do not present a serious long-term risk because they weaken mainly the aesthetic properties of woody plants. In the park in Nitra the following gall-inducing species occur abundantly: *Aceria fraxinivora* on *Fraxinus* genus, *Stenacis triradiatus* on *Salix* genus, *Rhyacionia buoliana* on *Pinus* genus, *Psylla buxi* on *Buxus* genus, *Aphis fabae* on *Phylladelphus*, *Euonymus* and *Robinia* genus, *Myzus cerasi* on *Prunus* genus, *Dysaphis crataegi* on *Crataegus* genus, *Tetraneura ulmi* on *Ulmus* genus, *Sacchiphantes viridis* on *Picea* genus, *Cynips quercus-calicis* on *Quercus* genus, *Diplolepis rosae* on *Rosa* genus, *Dasineura tiliamvolvans* on *Tilia* genus, *Dasineura gleditchiae* on *Gleditsia* genus, *Acericecis vitrina* on *Acer* genus.

The host plant orders and number of gall-forming species found are presented in Tab. III. The greatest number of gall-forming species was identified on the genus *Quercus* (28); the majority belongs to the Cynipidae family. Also a high number of identified species was found on the *Acer* (10), *Salix* (10) and *Populus* (9) genera. Of the total number, 28 species of gall-inducing organisms occurred on introduced

woody plants and 108 species on native woody plants. From all the species, 10 gall-inducing organisms occurred on both introduced and native woody plants.

Table II. Total number of gall-inducing species in individual orders and families.

Order	Family	Number of species
Prostigmata	Eriophyidae	29
	Phytoptidae	2
Lepidoptera	Tortricidae	2
Hemiptera	Psyllidae	2
	Aphididae	23
	Adelgidae	5
	Triozidae	1
Coleoptera	Cerambycidae	1
Hymenoptera	Tenthredinidae	5
	Cynipidae	27
Diptera	Cecidomyiidae	25

Table III. Gall-inducing arthropods associated with ornamental woody plants in Nitra City Park.

Host plant genera	Number of woody plant species			Number of gall-forming species
	native	introduced	total	
<i>Abies</i>	1	1	2	2
<i>Acer</i>	3	2	5	10
<i>Alnus</i>	2	0	2	3
<i>Betula</i>	1	0	1	1
<i>Buxus</i>	0	1	1	2
<i>Carpinus</i>	1	0	1	3
<i>Corylus</i>	0	1	1	1
<i>Crataegus</i>	1	0	1	2
<i>Euonymus</i>	1	0	1	2
<i>Fagus</i>	1	0	1	1
<i>Fraxinus</i>	2	0	2	6
<i>Gleditsia</i>	0	1	1	1
<i>Hibiscus</i>	0	1	1	1
<i>Juglans</i>	0	1	1	2
<i>Juniperus</i>	1	0	1	1
<i>Larix</i>	1	0	1	3
<i>Ligustrum</i>	1	0	1	1

Host plant genera	Number of woody plant species			Number of gall-forming species (Table III – continued)
	native	introduced	total	
<i>Lonicera</i>	1	1	2	2
<i>Philadelphus</i>	0	1	1	1
<i>Picea</i>	1	2	3	2
<i>Pinus</i>	2	4	6	3
<i>Populus</i>	4	1	5	9
<i>Prunus</i>	2	0	2	2
<i>Pseudotsuga</i>	0	1	1	1
<i>Pyracantha</i>	0	1	1	1
<i>Quercus</i>	2	1	3	28
<i>Rhamnus</i>	1	0	1	1
<i>Ribes</i>	1	0	1	2
<i>Robinia</i>	0	1	1	3
<i>Rosa</i>	2	0	2	3
<i>Salix</i>	2	0	2	10
<i>Sambucus</i>	1	0	1	1
<i>Swida</i>	1	0	1	1
<i>Taxus</i>	1	0	1	2
<i>Tilia</i>	2	0	2	7
<i>Ulmus</i>	3	0	3	3
<i>Viburnum</i>	2	1	3	1
<i>Vitis</i>	1	0	1	1

During the research 13 non-indigenous species were recorded, most of them trophically fixed on allochthonous woody plants, but some traversed to autochthonous woody plants. The recorded non-indigenous species in the city park originated in the Mediterranean (4 species), southwestern Asia (4), North America (4) or are of unknown origin (1). Species fixed on allochthonous woody plants are *Aceria pyracanthi* (Canestrini, 1890), *Aceria tristriata* (Nal., 1890), *Aceria erinea* (Nal., 1891), *Vasates quadripes* Schimer, 1869, *Psylla buxi* Targ., 1758, *Gilleteella cooleyi* Gill., 1907), *Obolodiplosis robiniae* (Haldemann, 1847), *Dasineura gleditchiae* (Osten Sacken, 1866), *Monarthropalpus flavus* (Schrank, 1776). The species, which caused damage to autochthonous woody plants, are *Aphis craccivora* Koch., 1854, *Dreyfusia nordmanniana* Eckst., 1890, *Hyadaphis tataricae* (Aizenberg, 1935), *Myzus persicae* (Sulzer, 1776).

Two of the identified species have been known in Slovakia only for a short time: the gall mite *Aceria pyracanthi* (Canestrini, 1890) was first detected in Slovakia in 2006 and the gall midge *Obolodiplosis robiniae* (Haldemann, 1847) in 2005/2006.

Obolodiplosis robiniae (Haldemann, 1847)

In July 2005 and 2006 the occurrence of a new species of gall-inducing midge which damaged leaves of *Robinia pseudoacacia* L. was recorded near Nitra (Cabaj - Čápor). This was the first occurrence of this gall midge in the Slovak Republic and has already been registered in several areas of Slovakia (Komárno, Čifáre, Cabaj-Čápor, Trnava, Zvolen, Hronský Beňadik, Gabčíkovo, Topoľčany, Banská Bystrica, Banská Štiavnica,

Nitra, Košice, Levice, Bratislava, Zlaté Moravce, Nové Zámky, Tesárske Mlyňany, Bánovce nad Bebravou, Partizánske, Piešťany, Bojnice, Prievidza,). It has moved from the lowland to higher ground. In Slovakia the gall midge has two or three generations annually. This gall midge species was found on *Robinia pseudoacacia* L., *Robinia hispida* L. (Botanical Garden SPU, Nitra), *Robinia pseudoacacia* cv. 'Unifolia' (Zvolen, Prague) and *Robinia neomexicana* A. Gray (Komárno) everywhere in Slovakia where the genus *Robinia* occurs. Currently the gall midge affects all the planted *Robinia* species. This species prefers the youngest parts of the host plants, which grow very strong. Along with other insect pest species, in future *O. robiniae* could contribute to the reduction of the invasive potential of the black locust tree in Slovakia.

Aceria pyracanthi (Canestrini, 1890)

This gall mite species probably comes from southern Europe or western Asia. Very little information about this species exists. During the research in 2006 we recorded it in November on Firethorn, which grows at the Botanical Garden SPU Nitra as a single site, and then in the city park in Nitra. The mite creates purple colored galls on the underside and on the upper surface of leaves. The galls are clearly visible and strongly tomentose. We have found no particularly harmful effect of this pest. We recorded only minor color changes in some damaged leaves.

In the Slovak area there is limited observation of the gall-forming organism as only a few scientists are interested in this group of organisms. Many of them observe mainly forest species. Most species have little importance in terms of damage to woody plants and long-time influence on hygienic conditions. But more attention should be paid mainly to ornamental woody plants, because gall-forming organisms diminish their aesthetic properties. Climate changes increase the activity of alien species, and new non-indigenous species occur. To be prepared for any eventuality, periodical monitoring of this organism group is very important.

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References

- BARTA, M. & CAGÁŇ, L., 2006a. Observations on the occurrence of Entomophthorales infecting aphids (Aphidoidea) in Slovakia. *BioControl*, 51(6): 795-808.
- BARTA, M. & CAGÁŇ, L., 2006b. Aphid-pathogenic entomophthorales (their taxonomy, biology and ecology). *Biologia* (Section Zoology), Bratislava, 61(21): S543-S616.
- BARTA, M., 2009. Entomophthoralean fungi associated with aphids in woody plants in the Arboretum Mlyňany SAS. *Folia oecologica*, 36: 1-7.
- BARTEKOVÁ, A. & PRASLIČKA, J., 2004. Population dynamics of aphids (Sternorrhyncha: Aphidoidea) on apple trees. *In*: Bauerová, M., Michalička, P., Palmárová, P. & Varga, M. (eds.): V Scientific conference of PhD. Students and young scientists. Proceeding from international conference, Nitra, UKF, pp.: 7-10. [in Slovak]
- BLACKMAN, R.L. & EASTOP, V.F., 1994. *Aphids on the World's Trees: An Identification and Information Guide*. CABI Publishing, Wallingford, 987 pp.
- CŠÓKA, G., 1997. *Plant Galls*. Agroinform kiadó, Budapest, 160 pp.
- GOGOLA, E., 1985. *Forestry, zoology and entomology – part Entomology*. Forestry and timber university, Zvolen, 208 pp. [in Slovak]

- GREGOROVÁ, B., ČERNÝ, K., HOLUB, V., STRNADOVÁ, V., ROM, J., ŠUMPICH, J., KLOUDOVÁ, K., 2006. Woody plants damage and its causes. ZO ČSOP, Prague, 361 pp. [in Czech]
- HRUBÍK, P., 1988. Animal pests of city greenery. Veda, Bratislava, 196 pp. [in Slovak]
- HRUBÍK, P., 1998. Results of animal pests research on woody plants in Urban environment. In: Anonymous (ed.): Actual garden and landscape design in term of environment changes. Proceeding from lectures from 24. seminar meeting Environment and public greenery in cities and country, Průhonice, The research institute of ornamental gardening, pp.: 54-67. [in Slovak]
- HRUBÍK, P., 1999. The first record of gall midge *Dasineura gleditchiae* (Diptera: Cecidomyiidae) in Slovakia. Entomofauna Carpathica, 11(1): 6-8. [in Slovak]
- HRUBÍK, P., 2007. Alien insect pests on introduced woody plants in Slovakia. Acta entomologica serbica, 12(1): 81-85.
- HRUBÍK, P. & JUHÁSOVÁ, G., 1997. Plant protection. Technical univerzity in Zvolen, Zvolen, pp.: 71-103. [in Slovak]
- HRUBÍK, P., SKUHRAVÝ, V. & BREWER, J.W., 1998. Susceptibility of 10 taxa of Boxwood (*Buxus* spp.) to attacks of the gall milde *Monarthropalpus flavus* Schrank, (*M. Buxi* Lab.) (Diptera, Cecidomyiidae) in 8-year experiments. Acta horticulturae et regioteecturae, 1(2): 33-35.
- KELBEL, P., 2001. Contribution to distribution of some gall wasp species in Botanical garden of P.J. Šafárik University in Košice. Folia oecologica, 28: 145-152. [in Slovak]
- KELBEL, P., 2002. Results from gall wasps (Cynipidae) monitoring on oak trees in Botanical garden of P.J. Šafárik University in Košice. Folia oecologica, 29: 243-255. [in Slovak]
- KELBEL, P., 2004. Gall-wasps (Hymenoptera, Cynipidae) associated with ten species in the "Quercetarium" Čifáre. Folia Oecologica, 31(2): 83-90.
- KELBEL, P., 2006b. Biotic acorn pests of selected oak species (*Quercus* spp.) in Slovakia. Pavol Jozef Šafárik University, Košice, 172 pp. [in Slovak]
- KELBEL, P., 2009. Results from monitoring of gall-inducing species on woody palnts assimilative organs in Botanical Garden of P.J. Šafarik University in Košice. In: Fulin, M. (ed.): Natura Carpatica – Proceedings of the East slovak museum, natural sciences. East slovak museum, Košice, pp.: 41-55. [in Slovak]
- KELBEL, P. & HLAVÁČ, P., 2004. Results from continuous monitoring of gall wasps (Cynipidae) in Arboretum Borová Hora. In: Hlaváč, P. (ed.): New trends in forest and landscape protection. Proceedings of scientific Works dedicated to Ing. Dr.h.c. Miroslav Stolina, DrSc. Technical University in Zvolen, Zvolen, pp.: 125-129. [in Slovak]
- KELBEL, P. & SUVÁK, M., 2008. Selected insect pests of woody plants in Botanical garden of P.J. Šafárik University and in Košice town residential area in changed climatic conditions. In: Knetigová, Z., Hořka, P., Mácsayová, M., Vozáriková, M. & Šusták, R. (eds.): Acclimatization and introduction of woody plants in the conditions of global warming: proceedings of papers from scientific conference. B.m.v.: Arborétum Mlyňany SAV, pp.: 159-169. (CD ROM) [in Slovak]
- KOBZA, M., 2003. Aphids (Aphidinea, syn. Aphidoidea) on woody plants of city greenery. In: Bernadovičová, S. (ed.): Woody plants in public greenery. Proceedings from conference with international participation. Košice, UPJŠ, pp.: 119-125. [in Slovak]
- KŘÍSTEK, J. & URBAN, J., 2004. Forest entomology. Academia, Praha, 448 pp. [in Czech]
- MALINA, R. & PRASLIČKA, J., 2008. Effect of temperature on the developmental rate, longevity and parasitism of *Aphidius ervi* Haliday (Hymenoptera: Aphidiidae). Plant Protection Science, 44(1): 19-24.
- MARHOLD, K. & HINDÁK, F., 1998. Checklist of Non-vascular and Vascular Plants of Slovakia. VEDA, Bratislava, 688 pp. [in Slovak]
- NIENHAUS, F. & KIEWNICK, L., 1998. Plant protection of ornamental woody plants. Eugen Ulmer GmbH & Co., Stuttgart, 460 pp.
- PFEFFER, A., HORÁK, E., KUDELA M., MÜLLER, J., NOVÁKOVÁ, E. & STOLINA, M., 1961. Forest protection. SZN, Praha, 838 pp. [in Czech]
- SCHNAIDER, Z., 1976. Atlas of tree and shrub damages caused by insects and mites. Państwowe wydawnictwo naukowe, Warszawa, 320 pp. [in Polish]

- SKUHRAVÁ, M., 2005. Species richness of gall midges (Diptera: Cecidomyiidae) in the main biogeographical regions of the world. *Acta Societatis Zoologicae Bohemicae*, 69: 277-320.
- SKUHRAVÝ, V. & SKUHRAVÁ, M., 1986. Gall midges (Cecidomyiidae, Diptera) on trees and shrubs of the Arboretum Mlýňany. *Folia dendrologica*, 13: 357-373.
- SKUHRAVÝ, V., SKUHRAVÁ, M. & HRUBÍK, P., 1992. Results of ten year gall midges research (Cecidomyiidae, Diptera) in Arboretum Mlýňany. In: Anonymous (ed.): International symposium at the occasion of the 100th anniversary of the Arboretum Mlýňany Foundation 1892 – 1992, Bratislava, pp.: 213-219. [in Czech]
- SKUHRAVÁ, M., SKUHRAVÝ, V. & MASSA, B., 2007. Gall midges (Diptera: Cecidomyiidae) of Sicily. *Naturalista Siciliana*, 4(31): 215-263.
- SKUHRAVÝ, V. & SKUHRAVÁ, M., 1998. Gall midges of forest trees and shrubs. *Matice lesnická, Písek*, 174 pp. [in Czech]
- STONE, G.N. & SCHÖNROGGE, K., 2003. The adaptive significance of insect gall morphology. *Trends in Ecology and Evolution*, 10(18): 512-521.
- VESER, J., 2001. Plant protection in garden. *Nezávislosť, Bratislava*, 201 pp. [in Slovak]

ЗГЛАВКАРИ КОЈИ ПРОУЗРОКУЈУ СТВАРАЊЕ ГАЛА НА УКРАСНИМ ДРВЕНАСТИМ БИЉКАМА У ГРАДСКОМ ПАРКУ У НИТРИ (ЈУГОЗАПАДНА СЛОВАЧКА)

ЈАН КОЛАР

Извод

Истраживање је спроведено у Словачкој у периоду 2004-2008, у градском парку у Нитри. Пажња истраживача била је усмерена на инсекте и гриње који проузрокују стварање гала на украсним дрвенастим биљкама у урбаној средини. Обављена је визуелна контрола дрвенастих биљака на терену, а једна врста је утврђена на основу прикупљених узорака симптома. Констатовано је присуство укупно 122 врсте инсеката и гриња (91 врста инсеката и 31 врста гриња). Најчешће биљке домаћини су представници родова: *Quercus* (28 врста), *Acer* (10 врста), *Salix* (10 врста), *Populus* (9 врста) и *Tilia* (8 врста).

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