ATLAS

of Biodiversity Ris

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The Rapid Colonization of the Introduced Black Locust Tree by an Invasive North-American Midge and Its Parasitoid

Milka Glavendekić, Alain Roques & Ljubodrag Mihajlović

Black locust (*Robinia pseudoacacia* L.; Magnoliopsida, Fabaceae), a tree native of North America, was introduced about 400 years ago into Europe to reforest certain areas and for ornamental purposes. However, this plant species is nowadays considered as an invasive in several European countries. During the recent years, a number of non-native phytophagous insects were reported to feed on the leaves of black locust in Europe. Most of these insects were suspected to have been introduced through the development of global trade, the increase of traffic and the movement of people and goods. Among them, the black locust gall midge *Obolodiplosis robiniae* (Haldeman) (Diptera, Cecidomyiidae), a *Robinia*- specific species native of the South-Eastern United States, showed a very rapid expansion throughout Europe. It also invaded China and Korea.

Spatio-temporal expansion of the black locust gall midge in Europe

Obolodiplosis robiniae was initially found in 2003 in the Veneto region of north-eastern Italy (Duso & Skuhravá 2004). During the following year, it expanded over northern Italy (Friuli-Venezia Giulia, Trentino-Alto Adige, Lombardia and Emilia Romagna), Czech Republic (vicinity of Prague) and in Slovenia. Then, it was successively recorded in most of Central and Western Europe and in the Balkans in less than 5 years (Figure **5**). Recent, unpublished records revealed its presence in 2008 in Macedonia and in the Corfu island where serious surveys noticed its absence in 2005. The latest record was from Bulgaria (Tomov et al. 2009).

Life history and damage of black locust gall midge

Obolodiplosis robiniae induces galls rolling downwards the margins on the leaflets of *R. pseudoacacia* (Figure **1**). The number of galls per leaf is variable (up to 8), depending on the level of infestation. Several larvae, usually 3 to 8, are feeding gregariously within the gall (Figure **2**). The black locust gall midge is a multivoltine species with three to four generations per year in Europe. Detailed studies carried out in Serbia revealed the following succession of generations: April-May (1st), June to the beginning of July (2nd), July-August (3rd), September-October (4th). Pupation occurs at different places according to the generation, within the gall during the 1st, 2nd and 3rd generations but the larvae of the 4th generation leave the gall to hibernate and pupate in the soil beneath the tree.

Usually, the 2nd generati
abundant in Italy and Se

The level of infestati
iable per site, from 20 to
and 25 to 55 % in Serbia
tion levels can result in a
liation of black locust by
of August. In order to co
the foliage loss, the defoli
ates new leaves from adv
which impacts its physiol
tion. In addition to black
damage have been observ
ornamental *Robinia* specie
and on the cultivar *R. pseu*
"Umbraculifera", which a
in the urban parks. Strong
are thus susceptible to res
cant aesthetic impacts. In
gall midge is affecting the
Robinia whereas it is consid
a strong negative effect on
duction in Korea.

Figure 1. Gall of black locust gall midge, *Obolodiplosis robiniae*, on a leaf of black locust. Photo: Lj. Mihajlović.

Figure 2. Gregarious larvae of black locust gall midge present in a gall. Photo: M. Glavendekić.

Figure 3. Adult of *Platygaster robiniae*, a larval parasitoid of black locust gall midge. Photo: M. Glavendekić.

Figure 4. *Platygaster robiniae* Buhl & Duso – pupal clusters and adults. Photo: M. Glavendekić.

ough the pathways of
ital introductions could
ascertained, strong susc-
on the trade of ornamen-
ts for planting. For
first midge symptoms in
found on an ornamental
. By another way, intro-
orfu probably proceeded
rt of people and goods
s from either Italy or
also likely that some of
ts were naturally dispersed
ddition, the invasiveness
st and its large, natural
g the last decade in
ituted a favourable factor
d of its related gall midge.

nchronous expansion ge parasitoids

ies on the biology and ecol-
locust gall midge revealed
of natural enemies, includ-
oid wasp, *Platygaster robiniae*
so) (Hymenoptera:
e – Figure **3**). This species
cribed from Italy, Czech
l Japan but it seems likely
parasitoid and its host
ced from North America
nd Asia (Buhl & Duso
iniae is a polyembrionic
ae being aggregated within
clusters of approximately
uals (Figure **4**). Adult emer-
s from July to late October.
e has quickly expanded fol-
novement of its host, and it
observed in a large part of
s colonized by the midge in
ure **6**). In Italy as well as in
biniae was observed only
er its host was found. In the
blic, it was found two years
st record of the midge but
nd Montenegro, Macedonia
a midges and parasitoids

observed during the 2nd and 3rd host generation (Buhl & Duso 2008). In Serbia, although the percentage of midge- galled leaves exceeded 10 percent at almost all localities during 2007, *P. robiniae* usually parasitized less than 10 % of the larvae except in Western Serbia, where the level of parasitism varied between 11.3 and 24.2 %. Indeed, the parasitism was very low during the 2nd generation (<1 %) but increased to up to 24 % during the 3rd and 4th generation. The first results on research on parasitoid fauna of *O. robiniae*, suggest that pupae cold also be parasitized. Pupal parasitoid was observed in 2007 in Serbia (Figure **7** and **8**).

It is thus expected that this kind of "natural" biological control, with the accidental introduction of a specific, non-native parasitoid following its exotic host, may result in a control of the invader populations. However, the current status of the host tree, tending to be considered as an invasive itself, could counterbalance these beneficial effects of the parasitoid expansion.

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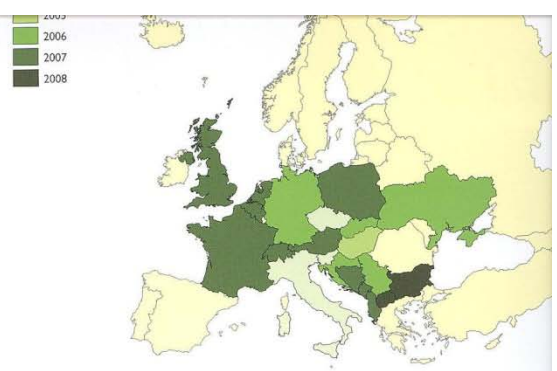

Figure 5. Spatio-temporal expansion of the black locust gall midge, *Obolodiplosis robiniae*.

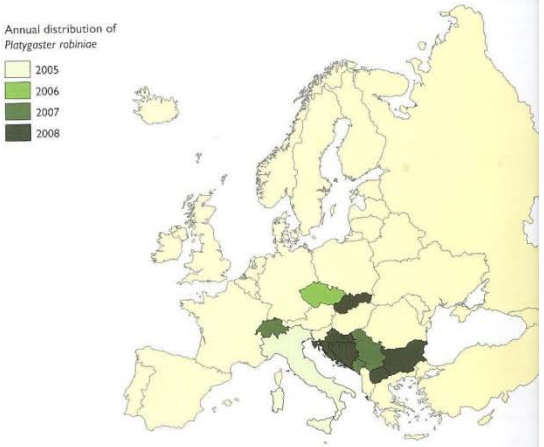

Figure 6. Spatio-temporal expansion of *Platygaster robiniae*, an hymenopteran parasitoid of the black locust gall

lodiplosis robiniae – pupa. Photo: M. Glavendekić.

Figure 8. Parasitoid emerging from pupa of *Obolodiplosis robiniae*. Photo: M. Glavendekić.