Asian sweet chestnut gallwasp, *Dryocosmus kuriphilus* (Hymenoptera, Cynipidae): first record for Romania

The Asian chestnut gallwasp (ACGW) (*Dryocosmus kuriphilus* Yasumatsu), is a member of the so-called "oak gall wasps" (Hymenoptera, Cynipidae, Cynipini) (Fig. 1). This tribe comprises phytophagous gall-inducing and gall-associated (inquiline) cynipoid wasps with about 1000 known species worldwide which associate with Fagaceae, mainly *Quercus* L. (Csóka et al. 2004). Hungary and Romania are among the most oak gallwasp species rich parts of Europe (Melika et al., 2000, 2003). ACGW emerged as a pest in the mid-twentieth century and is now one of the most dangerous insect pests of chestnut globally (*Castanea* spp.) (Aebi et al. 2006, Gibbs et al. 2011). This pest species disrupts growth by inducing gall formation on new shoots and leaves, eliminating nut production and causing a gradual decline in the vigor of these long-lived and slow-growing trees (EFSA 2010). ACGW is the only species in Cynipini tribe which induces galls on *Castanea* spp. While oak gallwasps rarely affect their host tree's fitness, attack by ACGW on chestnut commonly reduces wood production and fruit yield by 50–80% (Melika et al. 2003, Quacchia et al. 2012). The damage may continue for many years. Additionally, severe consecutive attacks may result in the death of the tree, probably in combination with other detrimental factors such as fungal infection, drought or severe attack by other herbivores (Dixon et al. 1986, Szabó et al. 2014).

Originating from China, it was established as a pest in Japan (1958), South Korea (1958), USA (1974), and Nepal (1999) (Gibbs et al. 2011). In Europe it was first recorded near Cuneo, Piedmont region, Italy in 2002 (Brussino et al. 2002). Since 2002 the pest had spread and established all over Italy, France and Slovenia (2005), Switzerland

Figure 1. The Asian chestnut gallwasp (ACGW), *Dryocosmus kuriphilus* (photo by Gy. Csóka)

(2009), Croatia (2010), Slovakia and the Czech Republic (2011), Spain (2012), Hungary (2013) (Szabó et al. 2014), Turkey and Portugal (2014) (pers. comm.). Till the detection of ACGW in Romania, Hungary was the most eastern European boundary of ACGW distribution. It has spread naturally over the south and south-western part of Hungary in two years: it was first detected in the most southwestern Zala county in 2013 (penetrated from Slovenia), then spread into Vas and Somogy counties in 2014. It was found in large numbers in Budapest, Pilis Mountains, Visegrad, Nagymaros in 2015 (pers. data, GyCs., GM) where it was probably introduced with infested trees carried from Northern Italy as plant for planting (Csóka et al. 2009). The human exchange of infected cultivars and material for grafting among chestnut growers, and the natural range expansion within nearby natural and planted stands are the main factors facilitating the rapid spread of ACGW.

Fresh developing galls of ACGW were found by visual observations in a *Castanea sativa* orchard (4.1 hectares) which is located near Sălard (Bihor County, Romania). The orchard was established in 2012 and the plant propagation material was imported directly from Italy. Typical ACGW leaf galls were detected on 3 chestnut trees (GPS coordinates: N 47º13'11", E 22º06'38", 125 m a.s.l.) (Fig. 2). According to the owner, infected leaves and galls on twigs were removed last year. On those trees we found also withered galls from the previous year (Fig. 3).

Figure 2. Typical ACGW galls on chestnut leaves in Sălard, Romania (photos by L. Radócz)

Figure 3. Withered ACGW galls on chestnut twigs in Sălard, Romania (photo by L. Radócz)

Life Cycle of ACGW. ACGW has one generation per year. Only the parthenogenetic females are known which laying eggs in the buds of *Castanea* spp. during summer, which then hatch in 30–40 days. First-instar larvae overwinter and grow slowly until the following spring at which point their growth rate increases leading to the formation of galls inside which the gallwasp larvae develop. Each gall comprises 1 to 15 larval chambers, with an average of 3.5 larvae per gall. The fully developed adult females stay for about 10-15 days in the gall before starting to emerge. After the emergence, females start to lay eggs (Gibbs et al. 2011).

Options for ACGW control. Strict control of the movement of infested plant material can reduce long-distance dispersal of ACGW to new areas within Europe. However, there are limited options available for managing existing ACGW populations and reducing their impact and spread on European chestnut plantations. Mechanical removal of infested twigs (pruning) and the protection of seedlings with nets, although effective, do not represent practical solutions because of their labour intensiveness and high expenses. Since the larval and pupal stages are protected within the galls formed by this species, conventional chemical control is regarded as largely ineffective (EFSA 2010). Developing resistant varieties of *Castanea* spp., for example a japanese-european hybrid Boche de Bètizac, could potentially be a viable management option, but this will only be beneficial for new planting and will not help existing chestnut plantations (EFSA 2010).

The most effective method for reducing ACGW infestation to date is the use of hymenopteran parasitoids as biological control agents in two possible ways: conservation and/or augmentation (using native parasitoids shifted onto the new host, ACGW) and the classical biological control with the introduction of a non-native parasitoid species from the place of origination, China (Bosio et al. 2013).

Within their native range in China ACGW populations are kept at low densities by natural enemies (Aebi et al. 2006). Despite having arrived in Europe without any natural enemies, the chestnut gallwasp has quickly recruited native parasitoids. These originate from oak and/or rose galls, which the native parasitoids regularly attack within their range. We are studying the native parasitoid complexes of ACGW across its expanding range in Italy (since 2002), Slovenia (since 2010), Croatia (since 2011) and Hungary (since 2013). Thirtynine native European parasitoid species from 6 Chalcidoidea (Hymenoptera) families have been recorded so far on ACGW from Italy till 2013 (Melika et al. 2014), 27 from Slovenia (Kos et al. 2015), 18 from Croatia, and 11 from Hungary (Matošević & Melika 2013, Szabó et al. 2014). Recruitment of parasitoids to ACGW depends on the actual parasitoid species composition of oak gallwasps to be found in the same locality and is higher in mixed chestnut-oak forests than in pure *Castanea* stands (Quacchia et al. 2012). The research has shown that the time lag between the introduction of the new host and the recruitment of native parasitoid community is short, however, the attack rates of indigenous parasitoid species are typically low (2-4.7%) (Aebi et al. 2006, Gibbs et al. 2011, Szabó et al. 2014); only in some years the parasitization rate might increase up to 32% (Santi & Maini 2011). Thus, native parasitoids cannot effectively control the ACGW and keep their populations under economic threshold.

The only solution seems to be the classical biological control, the introduction of a chalcid parasitoid, *Torymus sinensis* Kamijo (TS) (Hymenoptera: Torymidae), native to China and known as a highly specialized parasitoid of ACGW (Quacchia et al. 2012). Classical biological control using TS has been proven to be the only effective method of controlling the populations of ACGW and has been successfully applied in Japan, South Korea, USA (Moriya et al. 2002, Cooper & Rieske 2011). The introduction of TS to Europe was initiated in Italy in 2005, in 2011 in France. In both cases the introduction was very successful and the ACGW population densities were essentially reduced (Bosio et al. 2013, Borowiec et al. 2014, Matošević et al. 2014). The parasitoid was introduced to Hungary (Kriston et al. 2014) and Croatia (Matošević et al. 2014) in 2014, and to Slovenia in 2015 (pers. comm., GM). TS must be introduced to Romania as soon as possible, which will definitely slow down the spreading of ACGW all over the country.

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