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Note on mass occurrences of *Chrysomela vigintipunctata* (SCOPOLI, 1763) (Coleoptera Chrysomelidae Chrysomelinae) in Belgium

by Pascal LAYS

Museum, Institute of Zoology, University of Liège, Quai Ed. Van Beneden, 22. B-4020 Liège, Belgium. For correspondence : Rue F. Desoer 34, B-4031 Liège, Belgium.

Summary

Some observations of mass occurrences of *Chrysomela vingitipunctata* (SCOPOLI, 1763) (Coleoptera Chrysomelidae Chrysomelinae) on willows (*Salix* spp.) are reported from Belgium. The Chalcid wasp *Schizonotus sieboldi* RATZEBURG, 1852 **Belg. n. sp.** (Hymenoptera Pteromalidae) parasitized this chrysomeline; less than 3% of *C. 20-punctata* pupae were affected by this Chalcid wasp and died of this parasitosis.

Keywords : Col. Chrysomelidae, *Chrysomela*, Hym. Pteromalidae, *Schizonotus*, willows, *Salix*, Faunistics.

Résumé

Sont rapportées ici quelques observations d'occurrences massives de *Chrysomela vigintipunctata* (SCOPOLI, 1763) (Coleoptera Chrysomelidae Chrysomelinae) sur des saules (*Salix* spp.) en Belgique. *Schizonotus sieboldi* RATZEBURG, 1852 **Belg. n. sp.** (Hymenoptera Pteromalidae) parasite *C. 20-punctata*; moins de 3% des nymphes de cette chrysomèle étaient affectés par ce Chalcidien et périrent suite à cette parasitose.

Introduction

In spite of a large Palaearctic distribution : Europe (not in U.K.), Kazakh SSR, Russia, Mongolia, China, Korea, Taiwan, Japan (BARABÀS, 1976; BEENEN & WINKELMAN, 1993; DE MARSEUL, 1888; GRUEV 1979; GRUEV & TOMOV, 1986; HANSEN *et alii*, 1939; KIMOTO, 1989; KIMOTO & CHU, 1996; KLOET & HINCKS, 1977; LOPATIN & KULENOVA, 1986; MOHR, 1966; MOUSSET, 1984; PORTEVIN, 1934; REITTER, 1912; ŠCIBIOR, 1998; TAKIZAWA, 1985), *Chrysomela* (*Microdera*) *vigintipunctata* (SCOPOLI, 1763) (Fig. 1) (also found in the literature under the generic names of *Coccinela*, *Melasoma* and *Lina*) was, until recently, a species seldom observed in Belgium. In his 1963 Catalogue, DERENNE mentions *C. 20-punctata* from three localities only. Since that time, other occurrences (ancient and recent) have been added (BARVAUX, 1958-60, 1989; BEAULIEU, 1972, 1982; DE RUETTE, 1945; LAYS, 1986; LHOST, 1968, 1987). For about a decade, this chrysomeline has been recorded in many parts of Belgium, usually in large number on willows (my colleague J. FAGOT, who is currently undertaking the mapping of Chrysomelidae of Belgium, confirms it through his data). Similar

Fig. 1. *Chrysomela vigintipunctata* (SCOPOLI, 1763), *in copula* on *Salix alba* L., Angleur, 23.IV.1999.

observations of mass occurrences are reported, for instance, from neighbouring countries like Germany (ERBELING & TERLUTTER, 1995; TOPP & BERACZ, 1989).

C. 20-punctata, that has an obligatory univoltine development in Germany (TOPP, 1997a), but which is bivoltine in Bulgaria (PENEV & OVCHAROV, 1992), feeds, in Europe, on willow species and has been seen on *Salix alba* L., *S. caprea* L., *S. fragilis* L., *S. purpurea* L., *S.* × *rubens* SCHRANK, *S.* × *smithiana* WILLD., *S. viminalis* L. TOPP & BERACZ (1989) showed that the first, the second, the third and the last species cited enable the complete development of *C. 20-punctata*, with the highest survival rates occurring on *S. fragilis*, although, in the field, most individuals were found on *S. alba*; these authors also reported that *S. triandra* is strictly avoided, probably due to the presence of phenolglycoside salidroside (TOPP, 1997a). Within local populations a certain polymorphism regarding trophic selection exists and is positively correlated with fecundity (TOPP, 1997a; TOPP & BELL, 1992).

In Germany, the phenology (for the year 1987) of the different stages of *C. 20-punctata* can be summarized as follows : by mid-April, imagoes leave their hibernation sites and look for their food plants (willows); in the beginning of May, and up to the end of June, eggs are laid on leaves of willows; larvae will be observed from the end of May up to the beginning of July. At that time, imagoes die around mid-June. Pupae occur from mid-June up to the beginning of July. New adults appear from the end of June up to around the end of July; at that time, imagoes fly to hibernation sites where they will endure a diapause for some 9 months (TOPP & BERACZ, 1982; TOPP, BERACZ & ZIMMERMAN, 1989).

Observations

On 9 June 1997 (around 8 p.m.), *C. 20-punctata* was observed, by the author, in the locality of Angleur (5°35'30''E. - 50°36'00''N., alt. : *ca.* 70 m; Province of Liège, Belgium) on the left side of the Ourthe River (a tributary of the Meuse River) on two *Salix alba* L. The chrysomeline literally covered all the boughs of the willows. Imagoes were feeding on young leaves (lower face only). As attested by their still soft body and elytral light colour pattern, these adults belonged to the new generation; this was equally corroborated by the presence of numerous pupal exuviae found fixed on the lower face of laminae. Likewise occurring on these leaves were prepupal larvae, immobilized and waiting to pupate, as well as numerous pupae. More seldom recorded were larvae of younger instars.

When threatened, *C. 20-punctata* larvae, including the immobilized one of the prepupal instar, discharge secretion from 9 pairs of thoracic and abdominal glands (containing salicylaldehyde, *cf.* MATSUDA & SUGAWARA, 1980; PASTEELS *et alii*, 1982, 1984, 1988) of strong odour (not specially unpleasant to human nose) acting as a repellent, and this chemical defense seems very effective against insectivorous birds, ants and predacious bugs (TOPP, 1997a, 1997b; TOPP & BELL, 1992). One larva captured on 9 June '97, immobile, fixed to the lower face of a lamina, pupated the following day and on 14 June the imago came out.

Together with *C. 20-punctata*, but in a much lesser quantity, cooccurred adults of three other species of Chrysomelidae : *Plagiodera versicolora* (LAICHARTING, 1781), *Cryptocephalus ocellatus* DRAPIEZ, 1819 and *Crepidodera aurata* (MARSHAM, 1802); amongst these phytophagous species, only *C. 20-punctata* was the prominent defoliator. Was also captured on *Salix alba* foliage one female adult of the Chalcid wasp *Schizonotus sieboldi* RATZEBURG, 1852 (Fig. 2). Regarding the identity of the captured Chalcid wasps, a remark is necessary. The specimens obtained by the author were identified by the late P. DESSART as *Schizonotus latus* (WALKER, 1833) (pers. com. : 14/VIII/1997); this specialist provided a xerox copy of the key (from GRAHAM M.R.H. DE V., 1969 : 818-819) he used to identify the Chalcid wasps. When I used the key to

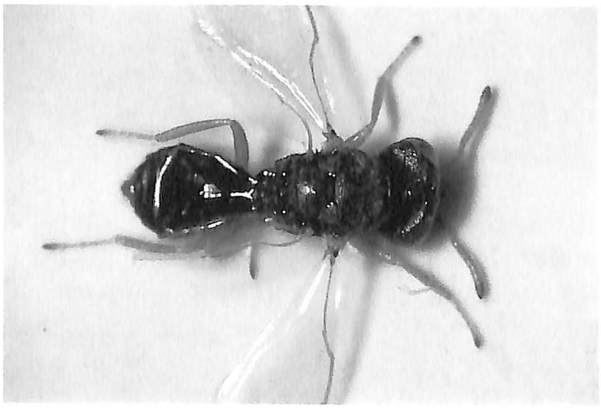

Fig. 2. *Schizonotus sieboldi* RATZEBURG, 1852, female, dorsal view.

identify voucher specimens of the same series, it clearly appeared that they belong to *Schizonotus sieboldi* RATZEBURG, 1852 (females : head in frontal view with clypeus projecting somewhat below the level of the ventral ends of the genae. Antennal funicle yellowish beneath, darker above, clava fuscous to blackish. Males : Flagellum yellowish with the clava blackish); therefore, I consider the Chalcid wasps considered in this paper as belonging to *Schizonotus sieboldi* RATZEBURG (this species is also known to parasitize an other chrysomeline : *Chrysomela populi* (L.), see GRAHAM, 1969). If one refers to the list of Pteromalidae of Belgium recently published by MITROIU (2001), this is the first occurrence of *Schizonotus sieboldi* in Belgium.

Regarding the other species : *Schizonotus latus*, one has to note that this species is known to parasitize *Chrysomela alnicola alnicola* BROWN, *Chrysomela* ? *scripta* and pupae of *Plagiodera versicolora* (LAICHARTING) (COX, 1994 : 424). With respect to Chalcid wasp *Schizonotus*, COX (1994 : 424) states that : " According to BOUCEK (1958 b), *S. latus* possibly also parasitizes *Chrysomela vigintipunctata* (SCOPOLI) "; a presumption that still needs confirmation.

The following day (10 June 1997, around 2 p.m.), a prospection was conducted along the sides of the Ourthe River between Angleur Proper and Colonster (a locality some 5 km upstream) : all the *Salix alba* checked had their foliage heavily invaded by hundreds, if not thousands of specimens for the tallest trees, of *C. 20-punctata*. Although no systematic measure was made, it seemed that the other species of willows were much less affected by those massive invasions. In the prospected section the following willow species grow : *Salix alba* L., *S. caprea* L., *S. cinerea* L., *S. purpurea* L. (subsp. *lambertiana* (SMITH) NEUMANN EX RECH. F.), *S. viminalis* L. and *S.* sp. (perhaps a hybrid of *S. purpurea* and *S.* × *rubra*).

Despite a sunny weather, no specimen of *C. 20-punctata* was seen flying neither on that day nor later, and they never tried to escape by this means when caught. Placed *in vitro*, in the shadow, at 25°C, the beetle was never seen flying or trying to fly; the species seems to require some special conditions in order to fly. When placed to some centimeters from a halogen lamp (20 W), the chrysomeline waits some seconds before flying towards the bulb. When positionned on a flat and smooth surface on its back, the beetle spreads its elytra and wings simulating a flight in order to turn over.

Amongst the specimens of *C. 20-punctata* brought back for observation on 9 June '97, some dead pupae (Fig. 3) were parasitized by 5 to 6 last instar larvae per pupa of the Chalcid wasp *Schizonotus sieboldi*, located on the lower face of the thorax and part of the abdomen, more or less covered by the wing sheaths and seeming to suck the beetle's pupa. A description of the pupa of *C. 20-punctata* is given by COX (1996) and KIMOTO (1962) and a photograph of a fresh freeze-dried pupa (as well as a larva) appears in LAYS (2001) (for the larva see also : STEINHAUSEN, 1996 : 73). The pupae were placed in a Petri dish at room temperature (25°C). Chalcid wasp larvae pupated on 11 June '97, around 10 a.m.; the same day, around 4 p.m., these pupae had already darkened. One week later, imagoes of *Schizonotus sieboldi* emerged between 17 to 19 June.

Fig. 3. Pupa (ventral view) of *Chrysomela vigintipunctata* parasitated by Chalcid wasp *Schizonotus sieboldi.*

On 29 May 2001, still in Angleur, on the young foliage of one tall *Salix alba*, pupae of *C. 20-punctata* were collected for observations *in vitro*. Out of a total of 69 pupae, 42 reached the imaginal stage; 13 died of undetermined origin; 4 died during early process of pupation (physiological defects); 8 died when passing from pupal to imaginal stage; only 2 died of parasitosis caused by *Schizonotus sieboldi* (no other parasitoid species was recorded). Each parasitized pupa produced one female and four males of *S. sieboldi.*

As far as data collected here allow, it appears that pupal mortality of *C. 20-punctata* of parasi-

tic origin owed to Chalcid wasp *S. sieboldi*, seems very low : 2.9%. These data confirm observations made elsewhere in Europe : in Germany, TOPP & BELL (1992) report also a low % of specimens parasitized by *S. sieboldi* and *Cleonice* (*Steiniella*) *callida* MEIGEN (Diptera, Tachinidae) (both species feeding on the larvae and the pupae of *C. 20-punctata*) : 4 to 8%; in Bulgaria, PENEV & OVCHAROV (1992) indicate that the pupae of *C. 20-punctata* were parasitized by *S. sieboldi*.

In 2001, on 14 June and 1 July, prospections were made on the same portion of the Ourthe river between Angleur Proper and Colonster and revealed the existence of *C. 20-punctata* imagoes on *Salix alba*. Later, on 29 August 2001, an other field visit was made, at that time, and as expected, no specimen of *C. 20-punctata* was seen; however, examination of willows' foliage (with damaged leaves) revealed the presence of pupal exuviae of the 20-spotted chrysomeline, and that on *Salix alba*, *S. purpurea* and more specially on *S. caprea*. Only some imagoes, and even one prepupal instar larva, of *Plagiodera versicolora* were seen on *S. alba*.

Discussion

Although *C. 20-punctata* is still well present in the studied site, and in many other localities in Belgium, it is apparent that its populations are markedly declining and the mass invasions that were occurring a few years ago, more specially on *Salix alba*, are less encountered. Insect population decrease is probably due to declining plant quality. One knows that a correlation exists between insect fecundity and the quality as well as the quantity of the soluble nitrogen levels in leaves; levels that evolve with time. Likewise, mass invasions of phytophagous insects may induce or increase secondary plant substance production that may affect plant palatability or digestibility or even produce metabolites influencing insect fecundity (EDWARDS & WRATTEN, 1980). TOPP (1997a) reports a higher mortality of larvae and adults of *C. 20-punctata* feeding on damaged *S. alba* foliage and this is probably owed to the combined effect of constitutive and inductive allelochemicals. For *S. fragilis*, grazing damages induced an increase of β-D-glucopyranose-1-O-trans-cinnamate concentration, an allelochemical that reduces the viability of *C. 20-punctata* (TOPP, 1997a; TOPP & BELL, 1992; GROSS & TOPP, 1997).

With regard to *Salix alba* on which the most spectacular massive invasions in the region considered here have been recorded, TOPP & BERACZ (1989) and TOPP, BERACZ & ZIMMERMAN (1989) have shown that amongst the four willow species studied (*S. alba*, *S. caprea*, *S. fragilis*, *S. viminalis*), *S. alba* is the species on which the lowest survival rate (3% in the best case) of *C. 20-punctata* occurs (overall survival from egg to dispersion flight) and this despite the fact that 70% of individuals (imagoes) they observed were feeding on this willow species. These authors explain this paradox as follows : upon leaving their hibernation sites in Spring, hungry imagoes alight on willow species whose foliage is the most developed at that time of the year, *i.e.* mainly on *S. alba*; and they conclude in stating that : " Beetles [*C. 20-punctata*] alighting, feeding and ovipositing on *S. alba* trees very early in the season probably have little evolutionary experience with this plant and do not know in advance what happens during the subsequent hibernation ".

To explain why, in less than a decade, *C. 20-punctata* passed from the status of very rare to very common species in Belgium, remains an uneasy task. This can be hardly corroborated with the relative abundance and distribution of its food plants; however, one has to note that *Salix fragilis*, which seems to be the most suited species for *C. 20-punctata*, is a rare to very rare species in Belgium, only located in some valleys of the Mosan phytogeographical district where it can be locally rather common to rather rare (DE LANGHE *et alii*, 1978; VAN ROMPAEY & DELVOSALLE, 1979). Aside from this potential limiting factor, one has also to add the fact that Belgium is situated on one of the Western borders of the *C. 20-punctata* geographical distribution area, and this may explain the sudden increase of records of this chrysomeline, but other factors, likewise, may have contributed to recent population movements of *C. 20-punctata*. To explain the recurring eruptive outbreaks of this willow beetle, TOPP & BELL (1992) provide four factors; it is probable that three of the given factors were already existing in the populations of *C. 20-punctata* in Belgium, prior to these mass invasions, and therefore could not explain the sudden phenomenon; on the other hand, these two authors state that " high temperatures in spring increase rate of reproduction ", and this

climatic cause is assuredly a factor that has changed quite significantly since two or three decades and may have contributed to the development and the expansion of *C. 20-punctata* populations in Belgium. However, since the factors underlying the recent movements of *C. 20-punctata* in Belgium are not perfectly known, as much for their nature as for their number, it seems difficult to make any prediction regarding the future of the faunistic drift of this species. The present general tendency is a reduction of their local populations. Is it the first steps of a process driving to a negative faunistic drift ? Or will the populations maintain their reduced strength and their occurrence in the considered area ? Only the years and decades to come will provide answers.

To close this note, one has to mention that some predators of *C. 20-punctata* have been identified so far : adults and larvae of *Aiolocaria hexaspilota* (HOPE) (Col. Coccinellinae) prey on the eggs, larvae and pupae in Japan (IWATA 1932, 1965 *in* COX, 1996); *Parasyrphus nigritarsis* (Diptera Syrphidae) was seen ovipositing on the egg batches in Switzerland (SCHNEIDER, 1953 *in* COX, 1996); in Germany, the larvae of this hover-fly were seen feeding on *C. 20-punctata* eggs, whereas the adults prey on the larvae (TOPP, 1997b; TOPP & BELL, 1992) (although no specific name is given, TOPP, BERACZ & ZIMMERMAN, 1989, reported to have recorded several species of Syrphidae) and *Tenthredella nigropicta* SMITH (Hymenoptera Symphyta Tenthredinidae) preying upon the larvae and pupae in Japan (IWATA, 1932 *in* COX, 1996); again in Germany, the shield-bug *Troilus luridus* (Heteroptera Pentatomidae) was observed feeding on *C. 20-punctata* eggs (TOPP & BELL, 1992). TOPP, BERACZ & ZIMMERMAN (1989) mentioned to have also observed Anthocoridae as predators. In Bulgaria, *Coccinella bipunctata* (Col. Coccinelidae) and several species of spiders are reported to feed on *C. 20-punctata* larvae (PENEV & OVCHAROV, 1992).

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