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To the biology of the honey locust seed beetle, Megabruchidius tonkineus (Pic, 1904) (Coleoptera: Chrysomelidae: Bruchinae)

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Abstract – Female genitalia, wing, egg, pupae, details of L_1 larva, bionomics and Hungarian collecting data of *Megabruchidius tonkineus* are given. With 13 figures.

Key words – Host plants, bionomics, larva, wing, female genitalia, egg, pupa, Hungary, *Megabruchidius*, Chrysomelidae

INTRODUCTION

Megabruchidius tonkineus was described from "Tonkin" by PIC (1904) as *Laria tonkinea*. The literature had not mentioned this species of Oriental origin for some 73 years, until WENDT (1980) first re-examined and placed it in the genus *Bruchidius* SCHILSKY, 1905. Four years later BOROWIEC (1984) established *Megabruchidius*, based on the type species *Megabruchidius bifoveolatus*, which was there described as new. In that paper *Megabruchidius tonkineus* was moved into this genus. Later in the generic revision (BOROWIEC 1987) *Megabruchidius bifoveolatus* was synonymized with *Megabruchidius dorsalis* (FAHRAEUS, 1839). The European presence of *Megabruchidius tonkineus* was first recorded by WENDT (1980) from Germany (albeit with host record based on mistaken speculation), while *Megabruchidius dorsalis* had its first European record from Italy (MIGLIACCIO & ZAMPETTI 1989).

Earlier studies have shown two bruchid species that develop in the seeds of woody plants in Hungary: *Bruchidius villosus* (FABRICIUS, 1792) in *Laburnum anagyroides* (SZENTESI 2006, SZENTESI & WINK 1991), and *Acanthoscelides* *pallidipennis* (MOTSCHULSKY, 1874) in *Amorpha fruticosa* (WENDT 1981, SZENTESI 1999). In 2001 a third species was reared from the pods of *Gleditsia triacanthos* that were collected in a city park of Budapest. The specimens were identified by KLAUS-WERNER ANTON as *Megabruchidius tonkineus* (JERMY *et al.* 2002, JERMY & SZENTESI 2002). ANTON moved a third species, *Bruchus tsinensis* PIC, 1923, closely related to *Megabruchidius dorsalis*, into *Megabruchidius* (JERMY *et al.* 2002).

The fourth known species of the genus, *Megabruchidius sophorae* was described from Japan as new, named after its host plant *Styphnolobium japonicum* (= *Sophora japonica* L.) (TUDA & MORIMOTO 2004). This tree species is one of the most common woody ornamental planted in some Hungarian cities, however, *Megabruchidius sophorae* has not been recorded from it so far.

Abbreviations of collectors' names – AB = ATTILA BARTHA, AG = ARANKA GRABANT, AK = ATTILA KOTÁN, AP = ATTILA PODLUSSÁNY, DP = DÁNIEL PIFKÓ, JT = JÚLIA TAMÁS, KV = KÁROLY VIG, LH = LÁSZLÓ HORVÁTH, OM = OTTÓ MERKL, PCS = PÉTER CSONTOS, PSZT= PETRA SZÖLLŐSI-TÓTH, TN = TAMÁS NÉMETH, ZGY = ZOLTÁN GYÖRGY.

NOTES ON MORPHOLOGY

Adult – BOROWIEC (1984) gives a detailed description of *Megabruchidius tonkineus* adults, which is supplemented hereby only with a few data and figures. The first abdominal ventrite of the males has a depression covered by large, light-coloured setae, which can also be observed on the New World species *Acanthoscelides pallidipennis* (MOTSCHULSKY, 1874). The function of this structure is so far unknown, perhaps associated with pheromone glands. The scutellum has two laterally directed triangular projections (Fig. 1), which resemble those of *Bruchus* LINNAEUS, 1767 (see fig. 22 in BOROWIEC 1988), the prosternal process is shown on Fig. 2, for the prosterna of other genera see BOROWIEC (1988: figs 14–15).

Because of the great variability of seed beetles, examination of genitalia is often unavoidable and thus practised for a long time, especially for males. As opposed to the aedeagi of the males, the female genitalia are poor in characters, therefore reliable identification of females is a problem even today. In the species of *Bruchus* the female genitalia are tiny and simple, not allowing distinction between species, while in *Bruchidius* (MERGEN, 1999) and *Spermophagus* SCHÖNHERR, 1833 (BOROWIEC 1991) more sclerotized and complicated structures are present. The morphology of the female genitalia of seed beetles was studied in detail by MERGEN (1999).

Since the female genitalia (Fig. 3) and the spermatheca (Fig. 4) of *Megabruchidius* was not published before, a figure of *Megabruchidius tonkineus* is included.

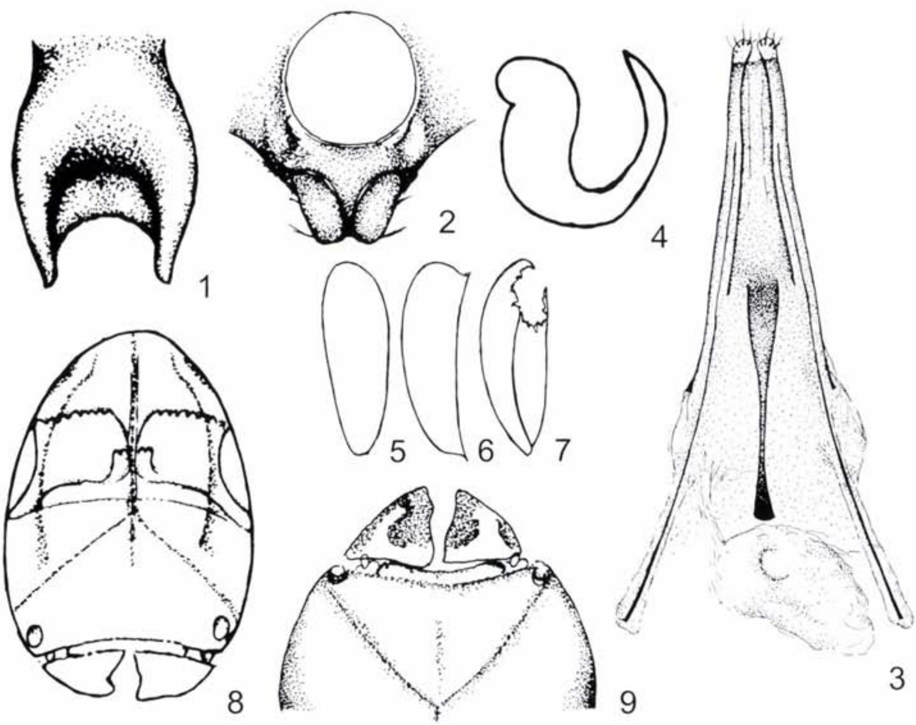
Wing venation of the seed beetles is perhaps unsuitable for distinguishing species, but it is much more important as a generic character, therefore the wing is shown on Fig. 13.

Egg – The egg (Figs 5–7) is yellow, elongate ovoid, with one end pointed the other rounded. Length 0.720–0.900 mm (n = 10, average 0.831), maximum width 0.280–0.400 mm (n = 10, average 0.317). The egg shell is finely punctate.

Larva – The larva hatches from the rounded (widened) end of the egg. The first larval stage (L_1) has developed legs, and is able to move quickly. The head capsule is strongly sclerotised (Figs 8–10), the mandibles are developed and strong, the prothoracic plate (Fig. 11) is pigmented, median arms with two teeth, posterior arm with 7–9 teeth. The prothoracic plate is similar to those of several species of *Acanthoscelides* SCHILSKY, 1805 depicted by PFAFFENBERG & JOHNSON (1976), but the strong and wide dentation of the a posterior arm is similar to that of *Amblycerus acapulcensis* KINGSOLVER, 1975. The body has 0.10–0.17 mm long hairs, and a spine is present at the first third of both lateral sides of the body.

The colour is white to pale yellow. The meso- and metathoracic segments are weakly sclerotized. One L_1 larva was measured; the length of head capsule was 0.20 mm, the maximum width was 0.20 mm, the width between outer edge of the eyes was 0.14 mm. The width of the anterior edge of the prothoracic plate was 0.13 mm, that of the posterior edge was 0.10 mm. The entrance hole made by the larva was 0.20 mm. The length of one L_4 larva was 6.00 mm.

Pupa – The mature pupa is yellow, with ventral side of thorax and the first abdominal ventrite nearly black (Fig. 12).



Figs 1–9. *Megabruchidius tonkineus* (PIC, 1904): 1 = scutellum, 2 = prosternal process, 3 = female genitalia, 4 = spermatheca, 5 = egg, dorsal view, 6 = egg, lateral view, 7 = egg with hatching hole, 8 = L_1 larva, head, dorsal view, 9 = L_1 larva, anterior part of head, dorsal view. Not to scale

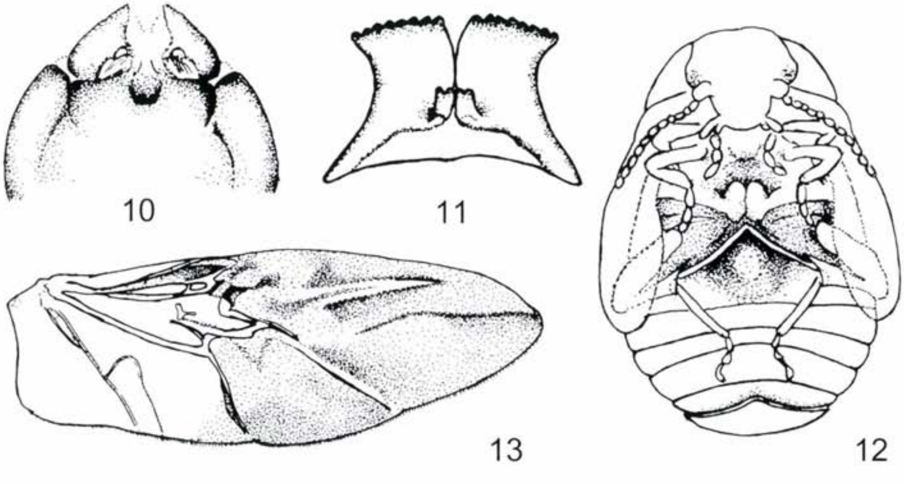
BIONOMICS

Gleditsia triacanthos is planted in Europe since the early 1700s (GENCSI & VANCSURA 1992), and it is a popular ornamental tree planted singly, in groups or lining roads throughout Hungary. *Megabruchidius tonkineus* is a good flier, it can find the host plant even if it is located streets away.

Females lay the eggs singly on the mature pod. Because of the tough pod wall, the female prefers pods with surface damages, where larvae can enter easily (T. JERMY, personal communication). The ovipositor is suitable for reaching the inside of the pod. When opening pods I observed egg shells on the surface of seeds immediately under an exit hole on the pod wall. This behaviour enables the insect to utilize even older, already used pods remaining on the ground from previous years. On several occasions I collected pods where all seeds were damaged. This, however, does not mean that only damaged pods or pods with exit holes are used for egg laying; in the nature, the nooks in strongly spiralised undamaged pods also had eggs.

In the laboratory females kept in petri dishes preferred laying eggs (second only to the seeds) also on the honey-watered rolled tissue paper (intended as a food source for the adults), perhaps because of its moisture and texture (deep creases). Females laid eggs into the exit holes of already damaged seeds. Also commonly used egg laying site was the cloth covering the rearing dishes. Such erroneous egg laying does not cause serious problems for the larvae, as they can move very vividly, with gently waving motions.

I could observe a female laying her first egg on the second day after mating. By the seventh day there were ten eggs. At room temperature, the first egg hatched on the fourteenth day, followed by the second on the twentieth day; three eggs died. The seven living larvae were further observed.



Figs 10–13. *Megabruchidius tonkineus* (PIC, 1904): 10 = anterior part of head, ventral view, 11 = prothoracic plate, 12 = pupa, 13 = wing. Not to scale

SHIMADA *et al.* (2001) reported first that, contrary to the larvae of *Bruchus* and *Callosobruchus* PIC, 1902, larvae of the genus *Megabruchidius* did not bore into the seeds immediately after hatching. Examining the inside of infested *Gleditsia* pods, along the suture of the pod there were burrows (perfectly round in cross-section) in the natural, cavity-like inner structures of the pod. A dead L_1 larva was also found there, proving that the larvae migrate within the pod.

In one seed it is possible for a second individual to develop, but the size of the latter can be as small as one-third of the fully developed adult. These second individuals are able to mate and produce viable offspring (T. JERMY, personal communication). However, the inside of a seed is almost entirely used up by the first individual, so there is little left for the development of a second larva.

At room temperature (23 ± 1.5 °C) the development from egg to adult takes about 50 to 80 days with considerable individual variability (T. JERMY, personal communication). The population of *M. tonkineus* resists cold winters (JERMY *et al.* 2002). Rearing from pods (approx. 30 pods) picked from the ground (some even remained from the previous year) resulted in 40 males and 68 females emerging. From the same sample I took 122 seeds that were soaked in water for a day and were dissected under a microscope. 32 larvae, 76 adults and 7 pupae were found, 4 seeds were uninfested and 3 were already empty. Adults already made an operculum, but died before emergence, apparently because of unfavourable conditions. The seven pupae found were in different stages of development, 4 were already dead, as were all the larvae. In the course of the rearing experiments, not a single parasitoid wasp was ever found.

Host plants – The first data on the host plants of *M. tonkineus* were published by WENDT (1980). She reported that two specimens were sent to her (Zoologisches Museum, Berlin) for identification from a hotel in Chemnitz. The sender supposed that the specimens had been introduced with white beans (*Phaseolus* sp.) from Vietnam, since such beans were stored in the same hotel room. In order to check that supposition, ten Hungarian and foreign bean varieties were tested in the Plant Protection Institute of the Hungarian Academy of Sciences, Budapest. The L_1 larvae penetrated into the seeds of all varieties, some 15% of the larvae reached the undeveloped L_2 instar, but all died. Similarly, the L_1 larvae died in the seeds of *Dolichos lablab, Glycine max, Lathyrus sativus,* and *Pisum sativum.* However, in laboratory egg laying was observed on the seeds of *Gleditsia caspica, delavai, ferox, japonica, macroacantha,* and *Gymnocladus dioicus*, and the larvae developed into adults (T. JERMY, personal communication). JÁNOS BODOR (editor of the horticultural magazine *Kertészet és Szőlészet* in Budapest) also conducted rearing experiment with beans resulting in no adult emerging, either.

Various species of *Gleditsia* (including *G. triacanthos*) and *Gymnocladus* contain 5-hydroxypipecolic acid (REHR *et al.* 1973) and triterpenoid saponins (KONOSHIMA *et al.* 1995), which are toxic to the non-adapted seed beetles and other seed predators. However, these apparently do not affect *M. tonkineus.*

Species of the genus *Gleditsia* originally occur in the Americas and Asia. In the New World a rather distantly related seed beetle species, *Amblycerus robiniae* (FABRICIUS, 1781) (tribe Amblycerini) is specialised on *Gleditsia triacanthos* (SOUTHGATE 1979). In Hungary, this species was observed once, introduced with seeds of thornless honey locust tree ("*inermis*", a cultivar of uncertain status) from North America (MERKL 2001). DI-IORIO (2005) mentioned another species, *Bruchidius endotubercularis* ARORA, 1980 infesting pods of *Gleditsia triacanthos* in Argentina. This Asian species, known to occur in India and Vietnam, was accidentally introduced into Argentina.

Distribution – Vietnam; introduced and established in Hungary (JERMY & SZENTESI 2002, JERMY *et al.* 2002, GYÖRGY & MERKL 2005), introduced but not established in Germany (WENDT 1980).

COLLECTING DATA FROM HUNGARY

Budapest – District V., Erzsébet tér, 30. X. 2005, leg. ZGY & LH (sample no. 10/2005, emerged 4 females, 2 males); Múzeum körút, 26. X. 2005, leg. ZGY & AB (sample no. 5/1/2005, emerged 2 females, 7 males); (sample no. 5/2/2005, emerged 5 females, 3 males); (sample no. 5/3/2005, emerged 1 female); (sample no. 5/4/2005, emerged 17 females, 15 males). – District VIII., Orczy kert, 15. XI. 2005, leg. ZGY (sample no. 13/2005, emerged 3 females, 3 males); Blaha Lujza tér, 8. XII. 2005, leg. ZGY (sample no. 29/2005, emerged 2 females, 3 males). – District IX., Haller utca, 8. XII. 2005, leg. ZGY (sample no. 28/2005, emerged 1 female, 2 males); Vágóhíd utca, 15. XI. 2005, leg. ZGY (sample no. 12/2005, emerged 9 females, 5 males). – District X., Maglódi út, 1. XI. 2005, leg. ZGY (sample no. 8/2005, emerged 1 male); Népliget, 1. XI. 2005, leg. ZGY (sample no. 9/2005, emerged 6 males); Népliget, 15. XI. 2005, leg. PCS & JT (sample no. 32/2005, emerged 8 females, 11 males). – District XI., Gellérthegy, 20. X. 2005, leg. ZGY (sample no. 4/1/2005, emerged 9 females, 12 males); (sample no. 4/2/2005, emerged 2 females); (sample no. 4/3/2005, emerged 2 females, 1 male); (sample no. 4/4/2005, emerged 1 male); Gellérthegy, 21. III. 2006, leg. TN (1 female); Gellérthegy, 23. III. 2006, leg. ZGY (sample no. 4/8/2006, emerged 2 females, 8 males); Gellérthegy, 6. IX. 2006, leg. ZGY (sample no. 95/2006, emerged 54 females, 38 males); Kosztolányi Dezső tér, 1. XII. 2005, leg. ZGY (sample no. 19/2005, emerged 5 females, 4 males); Ördögorom lejtő, 6. VI. 2006, leg. ZGY & DP (sample no. 28/2006, emerged 1 female). – District XII., Városmajor, 18. XI. 2005, leg. ZGY (sample no. 16/2005, 2 females, 1 male). – District XIII., Gyöngyösi utca, 28. III. 2006, leg. AK. – District XIV., Városliget, 15. XI. 2005, leg. ZGY (sample no. 11/2005, emerged 2 females, 3 males). – District XIX., Sibrik Miklós út, 25. X. 2005, leg. ZGY (sample no. 6/1/2005, emerged 1 female); (sample no. 6/2/2005, emerged 1 female, 1 male); (sample no. 6/3/2005, emerged 2 females, 1 male); Határ út, 15. XI. 2005, leg. ZGY (sample no. 14/2005, emerged 3 females). – District XX., Emília utca, 13. I. 2006, leg. ZGY (sample no. 1/2006, emerged 1 female, 1 male).

Pest county – Érd: Ófalu, 3. XII. 2005, leg. AG (sample no. 26/2005, emerged 1 female, 2 males). Gyömrő, 12. II. 2006, leg. AP (sample no. 1/2007, emerged 4 females, 8 males). Tápiószele, 11. VIII. 2007, leg. ZGY & PSZT (sample number 12/2007, emerged 5 females, 2 males). – Vác: Deákvár, 29. IX. 2006, leg. AG & OM (sample no. 94/2006, emerged 13 females, 10 males).

Fejér county – Székesfehérvár, captured inside a room, 27. XII. 2006, leg. KV (1 male, deposited in the Savaria Museum, Szombathely).

Further collectings of *Gleditsia* pods were made at various sites of Budapest, Miskolc, Kecskemét, Oroszlány, Kunszentmiklós and Ócsa, but rearing from these samples was unsuccessful.

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