Intraspecific larval aggression in two species of Hyperini (Coleoptera: Curculionidae)

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Two unusual types of behaviour (wandering and intraspecific aggressive behaviour) have been observed when rearing larvae of two species of the tribe Hyperini. Wandering of Hypera postica in search for food was observed in L1, L2 and L3 larvae, as well as in young L4 larvae. L1 larvae also disperse in response to crowding. Wandering of L2 to young L4 instars was a response to food shortage. Wandering of late L4 larva (‘prepupa’) occurs because of searching for a place to spin the cocoon and pupate. Encounters between the larvae may result in agonistic behaviour, and some larvae may die as a consequence of fighting. This aggression increases with food limitation. Agonistic intraspecific behaviour has not been described to date in weevil larvae and it probably may not occur under natural conditions when there is a plenty of food and larval densities are decreased by pathogens or parasitoids.

**Keywords:** resource competition; intraspecific aggressive behaviour of coleopteran larvae; pest; Hypera postica; Brachypera vidua; Palaeartic region

Introduction

Intraspecific aggressiveness (IA) is a common phenomenon among insects, may take different forms and may evolve for a variety of reasons. It is obligatory for social insects in their need to establish hierarchy and differentiate the adults into reproductive and non-reproductive castes. In other insects, IA is usually associated with sexual selection (Arnqvist and Rowe 2005), competition for limited and limiting resources (such as food, space, shelter, egg-laying sites; cf. Speight et al. 1999), and cannibalistic predation (Elgar and Crespi 1992), the latter being often subservient to the former two. Considering the intraspecific aggressive interactions among non-parasitoid holometabolan larvae, only competition and cannibalism apply.

Insects have evolved numerous strategies (e.g. host marking behaviour – Nufio and Papaj 2001) for avoiding intraspecific larval competition (hence also IA) and its interference with development. Laboratory experiments often show negative effects of increased density (e.g. Gibbs et al. 2004), but the adverse effects of overcrowding other than depletion of the food source are less easily demonstrated in natural populations. Both exploitative (scramble) and interference (contest) kinds of competition may be involved (Speight et al. 1999; Townsend et al. 2003). The
actual IA may range from a mild form of ritualized or actual contest for sources (usually food) up to terminating the competition ‘by means of murder’ (Stiling and Strong 1983, in larvae of various Spartina grass stem-borers (Coleoptera: Languriidae)).

Intraspecific larval cannibalism may occur among predators in a number of ways: as an extension of their normal behaviour, among non-predacious species as a by-product of feeding on another resource (e.g. decaying wood), as an abnormal behaviour owing to over-crowding or a scarcity of trophic resources, and as a result of the redeployment of trophic resources. The cannibalizing larvae benefit, although the overall costs of cannibalism may differ in non-kin and kin cannibalism. Cannibalism is frequent in beetle larvae, e.g. in predaceous (e.g. coccinellids – Michaud 2003) and xylophagous species (e.g. cerambycids – Ware and Stephen 2005); see Stevens (1992) for a review.

Cannibalism or any other kind of aggressive intraspecific behaviour of larvae has never been observed in the Curculionidae, although larvae of some species may indulge in interspecific aggression. Larvae of some taxa are parasitic on other insects (for a review, see Sugiura et al. 2004). Larvae of some weevils destroy minute insects from other orders, either food competitors (Hemiptera: Aphididae, larvae of Hymenoptera: Cynipidae and Tenthredinidae) or potential predators (larvae of Diptera: Cecidomyiidae) (Scherf 1964; Sugiura et al. 2004).

An incentive for writing this paper was the observation by the first author (JS) that the larvae of two Hyperini species (Coleoptera: Curculionioidae), both ectophagous herbivores, may show a pronounced intraspecific aggression in laboratory cultures, though this has never been observed in the field. Larvae of most Hyperini species develop on the surface of plants, feeding mainly on leaves and sometimes on flowers (Dieckmann 1989). Ectophagy is an apomorphic trait in the Curculionidae (Dieckmann 1989), and it is shared by the two Hyperini species studied (Skuhrovec 2003, 2005b; Costa et al. 2004). Only a few species may develop inside the inflorescences, e.g. Hypera nigrirostris (Fabricius, 1775) (Skuhrovec 2003), H. gracilenta (Capiomont, 1868) and Limobius borealis (Paykull, 1792) (Winkelmann and Skuhrovec 2007). Mature larvae spin cocoons in which they pupate, and the adults hatch after 1 or 2 weeks (Scherf 1964).

The larvae of all Hyperini species pass through four instars (Skuhrovec 2006). The fourth instar (L4) can be subdivided into two nearly equally long periods: in L4a, the larva eats leaves of its host plant, while in the following L4b (‘prepupa’) it searches for a place to spin the cocoon and pupate (Skuhrovec 2006). The larvae are apodous, and their locomotion is looper-like. The mouth-parts are well developed, but perform only trophic functions and are never used in combats.

However, we have found no published evidence of the coexistence of contests with suicidal combats for any species of Hyperini or, indeed, any other holometabolan. Such situations have been observed and experimentally analysed in Hypera postica, and observed in a rare Brachypera vidua. The results of experiments were combined with observations of the behaviour of larvae in the field, cultures and during experiments. We attempted to find their potential association with the instar and presence or absence of food, and discussed them in terms of their potential adaptive value.
Material and methods

Hyperini species

Hypera postica

The alfalfa weevil, *Hypera postica* (Gyllenhal, 1813), is a species autochthonous in the Palaearctic region (Skuhrovec 2013), but it was introduced in the Nearctic region at the end of the nineteenth century (Titus 1911; Kippenberg 1983). It develops on plant species belonging to nine genera of Fabaceae (Skuhrovec 2005b: *Astragalus*, *Galega*, *Lathyrus*, *Lotus*, *Lupinus*, *Medicago*, *Melilotus*, *Trifolium* and *Vicia*). The alfalfa weevil is known as a serious pest of alfalfa (*Medicago sativa* L.), mainly in the Nearctic region (Titus 1911; Berberet et al. 1987; Hoff et al. 2002; Skuhrovec 2006), while it is not noxious in its original area. The larvae occur on the top of the stems in loose groups. The feeding of *H. postica* larvae takes place on the surface of plants; small first and second instars (L1 and L2) usually feed on the youngest parts of alfalfa (the growing stem tips) while large third and fourth instars (L3 and L4) may feed on the opened leaves as well (Miller 1956; Hoff et al. 2002; Skuhrovec 2006). Large larvae cause a serious defoliation of alfalfa (Miller 1956; Hoff et al. 2002; Skuhrovec 2006).

The larvae of *Hypera postica* (all four instars) were collected near the villages Kačice (50°09'14"N, 14°00'00"E (WGS-84), 390 m above sea level, a.s.l.) and Raná (50°26' 00"N, 13°45' 20"E (WGS-84), 380 m a.s.l.) in northwest Bohemia during the years 2002–2005, by sweeping field-grown *Medicago sativa*. The instars were identified according to Skuhrovec (2006). Larvae were reared in Petri dishes with moist filter paper at the bottom; maintenance of proper humidity is essential (Barnes and Ratcliffe 1967).

Body lengths of instars were: 2.0 mm for L1, 2.0–2.5 mm for L2, 2.5–6.5 mm for L3 and 5.5–10.0 mm for L4 (Skuhrovec 2005a; data from alcohol-preserved, possibly slightly shrunken specimens).

Brachypera vidua

The other species, *Brachypera vidua* (Gené, 1837), is rare and occurs in the South of France, northern Italy, Switzerland, Germany, Gotland Island (Sweden), the Czech Republic (Skuhrovec 2013), and also in Norway (Silfverberg 2004) and Bosnia and Herzegovina (Germann 2011). The species was transferred to the genus *Brachypera* from the genus *Hypera* on the basis of larval morphology (Skuhrovec 2008). It inhabits rock-steppe and forest-steppe biotopes. Adults of this species are nocturnal (Strejček and Dieckmann 1987). The species is monophagous on *Geranium sanguineum* L. (Geraniaceae) (Skuhrovec 2005b). *B. vidua* is a rare species in its whole range. Collecting of *B. vidua* is difficult due to its nocturnal activity and early activity in April as larvae. Larvae of *B. vidua* are solitary: no more than one larva has ever been found at the same stem top (JS, unpublished data).

The larvae of *B. vidua* were collected individually on *Geranium sanguineum* in the rock-steppe near the village Dubičky in northern Bohemia (50°36’ 59”N, 14°01’ 05”E (WGS-84), 490 m a.s.l.) during the years 2002–2004. Only two localities of this rare weevil are known in the Czech Republic at present (Skuhrovec 2003). Consequently, the sample of collected larvae allowed only for a limited number of experimental
replications. The instars were identified according to Skuhrovec (2006). Larvae were reared as those of the alfalfa weevil. L1 was not found.

Body lengths of each instar were: 3.5–4.5 mm for L2, 4.0–6.0 mm for L3 and 4.5–12.5 mm L4 (Skuhrovec 2003; data from alcohol-preserved and possibly slightly shrunken material).

The larvae of *H. postica* were collected by sweeping *en masse*, and the solitary larvae of *B. vidua* were collected by individual search; consequently, we have no information on the degree of kinship of the individuals used in experiments. Larvae of both species were reared in the laboratory during the years 2002–2005.

**Experimental design**

We attempted to find out what factor is responsible for the intraspecific aggressive behaviour of larvae in laboratory cultures. Four separate experiments were carried out with *H. postica* and four with *B. vidua*. We tested altogether 800 individuals of *H. postica* and 40 individuals of *B. vidua*. Larvae of *H. postica* were tested in groups of four individuals, and each experiment involved 20 replications; in *B. vidua*, we tested two groups of two individuals in each experiment. Different individuals were used in each experiment and replication.

In *H. postica*, the two stages of the 4th instar, L4a and L4b, were included in all of the experiments simply as L4, but the differences in their behaviour during the experiments were recorded. In *B. vidua*, stages L4a and L4b were distinguished *a priori* in single-instar experiments (1v and 2v) but not in mixed-instar groups (3v and 4v).

The experiments lasted 30 minutes in both species. When the larvae continued to fight, the experiment was carried out until the following day (12 hours) without interim controls.

The goals and methodological details of the experiments with *H. postica* and *B. vidua* are summarized below.

**Experiments with Hypera postica**

**Single-instar groups**

**Experiment (p1):** Four larvae of the same instar were put in the centre of a Petri dish containing a sufficient amount of small leaves of *Medicago sativa* placed at three sites along the dish perimeter. All four instars were tested independently. The experiment was designed to test whether the larvae attack each other when the food supply is sufficient.

**Experiment (p2):** The experiment was designed as in (p1), but with no leaves of *M. sativa* in the Petri dishes. Larvae were deprived of food, and we tested whether a larva would attack other individuals or search for leaves to feed on.

**Mixed-instar groups**

**Experiment (p3):** Two small larvae (L1 and/or L2) and two large larvae (L3 and/or L4) were put into a Petri dish containing food (*M. sativa*) as in the
The experiment was designed to test whether the larger larvae are more aggressive than the smaller ones when the food supply is sufficient.

**Experiment (p4):** The experiment was designed as in (p3): two small and two large larvae without any food were put in a Petri dish. This experiment was a combination of (p2) and (p3) and aimed to test whether the larger larvae are more aggressive than the smaller ones when there is no food available.

*Experiments with Brachypera vidua*

**Single-instar groups**

**Experiment (v1):** As in (p1) above, but L1 and L4b were not examined, only two larval individuals were used, and *Geranium sanguineum* was used as the feeding plant.

**Experiment (v2):** As in (v1) – generally, and (p2) – the larvae were deprived of food.

**Mixed-instar groups**

**Experiment (v3):** As in (v1), one small larva (L2) and one large larva (L3 or L4) were put in a Petri dish with the food (*Geranium sanguineum*).

**Experiment (v4):** The experiment was designed as in (v3): one small and one large larva (L3 or L4), but no food, were included in Petri dishes. This experiment was a combination of (v2) and (v3).

*Behavioural records*

The following elements of behaviour were recorded: combats contra feeding, the offensive or defensive functions of larvae and the formation of combat balls. These types of behaviour were recorded on video with a digital camera (SONY DCR-HC20) or as photographs with a digital camera (OLYMPUS C-765). We defined combat-related behavioural elements as follows.

*Bobbing, to bob* (Costa et al. 2004) – larva adheres to the ground (or to another larva) with posterior abdominal segments, and checks its surroundings by jerky movements of its head and the anterior part of the body.

*Combat ball* – a cluster formed by several twisted fighting larvae (Figure 5).

*Defensive larva* – a larva attacked by another larva (the roles of defensive and offensive larvae are interchangeable during the fight).

*Offensive larva* – a larva attacking another larva.

*Wandering* – peregrination of larvae, seemingly aimless, and mainly in search for food or pupation site.

All the material (larvae, weevils, photographs and recordings) is deposited in the first author’s collection (JS) at the Group Function of Invertebrate and Plant Biodiversity in Agrosystems, Crop Research Institute.
Statistical analyses

To examine the effect of instars and the presence of food on aggressive behaviour of the weevils, the data from experiments with *H. postica* were expressed as the number of fights observed during individual experiments (dependent variable), the instar number (L1–L4) and the presence/absence of food during the experiment (factors). The data were analysed using a two-way General Linear Model (GLM) ANOVA (Poisson distribution of errors, log link function) with interactions. The effect of the presence/absence of food on the number of aggressive interactions (fights) in mixed-instar groups was analysed by a one-way GLM ANOVA with a Poisson distribution of errors and a log link function. Analyses were performed in STATISTICA 6.0 (StatSoft Inc. 2001). Data from experiments with *B. vidua* were not sufficient for statistical treatments.

Results

Formation of a persistent combat ball always resulted, in both Hyperini species, in the death of the larvae involved.

*Hypera postica* (Figures 1–3)

Single-instar groups

The number of fights recorded during the experiments was influenced by instar (Wald Statistic (Wald Stat.) = 27.11; df = 3, 153; *p* < 0.01) and by the presence of food (Wald Stat. = 19.27; df = 1, 153; *p* < 0.01). The interaction of the factors (instar age and presence of food) was not significant (Wald Stat. = 3.19; df = 3, 153; *p* = 0.36). Attacks were more frequent among larvae of L2, L3 and L4 and in the absence of food (Figure 1).

Experiment (p1). See Figure 1. Larvae of all instars started immediately to bob around, and when they touched any kind of object (leaves of *Medicago sativa*, another larva), they moved closer to it. If the object was a leaf, the larva would sample it and, eventually, eat it. When the larva touched another individual, it continued to bob, and for some time repeatedly touched the other larva; then the attack followed (Figure 5). The mode of attack was constant: the offensive larva twisted itself around the defensive one and pressed upon it (Figure 5). The defensive larva rotated and jerked at the ground, and tried to release itself. If the offensive larva relaxed its grip after a while, the defensive larva could extricate itself. The fight was then resumed, or the offensive larva started bobbing again and tried to find another object in its vicinity (Figure 5). Later, the offensive larva might attack again (the same or another defensive larva) or move in another direction. The roles of the offensive larva and the defensive sometimes changed during the fighting.

The fighting larvae sometimes came close to alfalfa leaves or upon the leaves, and if they stopped the fight, they could taste the leaves. Both offensive and defensive larva preferred the food to the fight on almost all occasions. Nearly all of the larvae were eating leaves after 10 minutes (see Figure 3).

If several larvae were clumped and formed a combat ball (see Figure 5), the fights might have continued longer since the larvae had been joining the ball by turns.
However, they always stopped fighting when food was found. The fights sometimes lasted for only a few seconds, and sometimes for the whole day (particularly in combat balls).

The youngest (L1) and the oldest (L4b) larvae wandered more than the others.

Experiment (p2). See Figure 1. Two major activities were apparent: wandering and fighting. The youngest (L1) and oldest larvae (L4b) wandered more than the others. L4b larvae did not fight, even when they encountered one another. When the other larvae (L2–L4a) encountered each other, the fighting usually started immediately, though every body contact did not result in a fight. On several occasions, all the larvae joined the fight, formed a combat ball (see Figure 3) and continued to fight even over the last regular control (30 minutes). All the larvae forming the combat ball were found dead after 12 hours (or earlier). Their tissues, at sites attacked by other larvae, were black owing to necrosis.

Mixed-instar groups

In mixed-instar groups, attacks were more frequent when food was absent (Wald Stat. = 7.84; df = 3, 76; p < 0.01, Figure 2).

Figure 1. The number of fights observed in experiments with groups of Hypera postica larvae of various instars (L1–L4), in the presence (plain boxes) or absence (hatched boxes) of food (leaves of Medicago sativa). Filled circles and squares indicate the mean, boxes indicate confidence intervals, whiskers show the non-outlier range and empty circles represent outliers.
Experiment (p3). See Figure 2. The results were the same as in (p1). The older larvae (L3/L4) reversed the attacks of the small larvae (L1/L2) by employing their size and body mass. Finally, all the larvae were eating the leaves, and no fights were taking place.

Experiment (p4). See Figure 2. The results of this experiment combined those of the previous experiments (Figure 2). The fights occasionally resulted in the death of all the larvae. The bodies of dead larvae were twisted into a combat ball.

The possible behaviours of all the instars of Hypera postica (L1, L2, L3, L4a and L4b) are summarized in Figure 3.

Brachypera vidua (Table 1, Figure 4)
All experimental data are summarized in Table 1.

Single-instar groups
Experiment (v1). The behaviours of B. vidua larvae during mutual attacks were generally similar to those of H. postica. When a larva found the leaves of Geranium
sanguineum, it fed upon them, but occasionally attacked another larva, if the latter moved into its vicinity. L3 and L4a were more aggressive than the youngest larval instar used in the experiment (L2). The prepupal larvae L4b bobbed or wandered, avoiding the fights (see Figure 4).

Experiment (v2). The general behaviours were similar to those in the experiment with the larvae of H. postica. Larvae attacked other larvae when food was not available. L3 and L4a were more aggressive than the youngest larval instar used in the experiment (L2), and L4b did not fight even when they encountered (see Figure 4).
Mixed-instar groups

Experiment (v3). Mutual attacks between larvae of *B. vidua* were similar to those in (v1). Larvae occasionally attacked other larvae, even when there was enough food.

Experiment (v4). The results were similar to those obtained in the previous experiments with the larvae of *B. vidua*. The frequency of attacks was similar to those in (v3).

The possible behaviours for all the instars (L2, L3, L4a and L4b) of *Brachypera vidua* are summarized in Figure 4.

Discussion

Wandering

Wandering was observed in all the instars of both Hyperini species, but its function might have been different in different instars. In particular, the motives of L1 and L4b may differ from those of other instars.

The main motive was apparently a search for food (observed in L1, L2, L3 and L4a). The wandering of individuals of older instars (L2, L3 and L4a) only occurred when no food was available.

The youngest larvae (L1) also have dispersal motives for wandering. The eggs of *H. postica* are laid in groups of three to 30 eggs into the stem of the alfalfa. The first larva hatched from a large group of larvae has to wander to find a suitable site for itself (and its own future older instars that will require more food and space).

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Figure 4. A summary of the possible behaviours of each instar of *Brachypera vidua* (L2, L3, L4a and L4b).
Egg-laying behaviour and the resulting activity of L1 are unknown in B. vidua, but taking into account their solitary habits and high aggressiveness of older larvae, we can hypothesize that single eggs are being inserted into Geranium stems. Consequently, the dispersal motive seems to be stronger for H. postica than for B. vidua. A similar strategy of L1 was observed in other Coleoptera (Coccinellidae – Hodek and Honek (1996)). There are two major motives for dispersal – finding food and avoiding competition (Speight et al. 1999).

The development of L4 instars takes twice as long as the development of other instars, a phenomenon known also in other Coleoptera (e.g. Carabidae – Saska and Honek 2004). The first stage, L4a (‘mature larva’), spends a great deal of time feeding, while the subsequent one, L4b (‘prepupa’), stops this activity. The main motive for wandering of the latter stage is undoubtedly search for a pupation site where L4b could spin the cocoon and the subsequent pupation could take place. This is probably also the main reason why L4b avoided fighting. Such behaviour of L4b was observed in both Hyperini species studied.

**Intraspecific aggressive behaviour (Figure 5)**

*Hypera postica*

All the fights took place only after contacts between or amongst the larvae searching for food; we have no indication that larvae would be looking for potential competitors. After finding food, the wandering stopped (as for L1 and L4b, see above), and chances of encounters with other larvae were minimal. Fighting was observed only in cultures, never in the field.

Larvae of *H. postica* abound in fields of alfalfa, which always provide plenty of food. Larvae occurred in loose aggregations at the tops of the alfalfa stems. Large and compact cooperative aggregations functioning to protect against predators, such as those described by Costa et al. (2004) for larvae of another hyperine species *Phelypera distigma* (Boheman, 1842) were never formed by larvae of *H. postica*. The number of *H. postica* larvae in the aggregation is controlled by the pathogenic fungus *Zoopathora phytomonii* (Arthur): when more than three larvae occur at the top of a stem, the occurrence of the fungus is enhanced (Kuhar et al. 1999), and the abundance of the whole population of *H. postica* declines. The larvae of *H. postica* are also parasitized by diverse species of Hymenoptera, e.g. *Bathyplectes anurus* (Thomson) (Ichneumonidae; Kuhar et al. 1999), which may potentially exert similar influences.

The behaviour of *Brachypera vidua* differs in many respects from that of *H. postica*. The larvae continued to fight, even when the food was available; only L4b did not fight, even when they encountered each other. In the field, the larvae of *B. vidua* occur singly at the tops of stems near the buds and do not form any clusters. Consequently, we could see the intraspecific aggressive behaviour in the laboratory cultures only.

**Wandering and non-aggressive behaviour in the field**

The larval intraspecific aggressive behaviour has not been observed in the field because the larvae behaviourally eschew dangerous situations.
The wandering L1 of *Hypera postica* must find a suitable site to complete its development. The chances of encounters leading to fights are decreased by the dispersal of larvae during the search, and, moreover, food is nearly always present since the larvae hatch from eggs laid on the host plant.

Figure 5. Intraspecific larval aggression of *Hypera postica*. Twisted fighting larvae formed a cluster named a ‘combat ball’. All the fights took place only after contacts between or amongst the larvae searching for food, not among those looking for potential competitors. Fighting was observed only in cultures, never in the field.

The wandering L1 of *Hypera postica* must find a suitable site to complete its development. The chances of encounters leading to fights are decreased by the dispersal of larvae during the search, and, moreover, food is nearly always present since the larvae hatch from eggs laid on the host plant.
The L1 larvae that are unsuccessful in finding a proper site die in either this or future instars.

L2–L4a occur on their main host plant, *Medicago sativa*, in small and loose clusters with plenty of food around. Aggressive encounters are thus nearly eliminated. Fungi and parasitoids would regulate the density of accidentally crowding larvae, and the population is always spatially diluted even if its density is high. L4b avoid combats during their wandering; a lack of suitable sites for spinning the cocoon and pupation was observed neither in the field nor in cultures.

Another situation is obtained with L2–L4a of *B. vidua*. They are solitary and never encounter each other. Old L4b can encounter each other during their wandering but they do not attack each other.

**Significance of aggressive behaviour in cultures**

The aggressive intraspecific behaviour of larvae of *Hypera postica* has never been observed in the field on *Medicago sativa* under the conditions of permanent plenitude of food and lack of crowding. However, the ability to carry out fights as observed in cultures, with their definite techniques and predictable outcome, must have evolved under natural conditions.

The transient combats in cultures with food available are obviously due to crowding; the bodily contacts of the larvae may function as stimuli for such a behaviour. Such a behaviour may be advantageous also in the field since an occasional occurrence of crowding may be presumed. Necessity to establish its own feeding and future pupation site is then essential for a larva. Wandering and transient combats may be synergistic during dispersal of the population, and the transient combats are undoubtedly adaptive.

What is more difficult to explain is the engagement of both offensive and defensive larvae in mortal combat balls in situations of the complete absence of food, and a seeming absence of any effective mechanism preventing involvement in these combats (cf. Ruxton et al. 2004). We can envision a variety of temporary field situations in which the hungry larvae could encounter each other, such as their aggregation on the ground caused by their fall from a shattered alfalfa plant, or the exhaustion of the food supply on an isolated stray alfalfa plant. However, the behaviour seems maladaptive – the fitness of both offensive and defensive larvae becomes zero. Evidently, better results in term of both inclusive and individual fitness would bring a combat strategy with obvious winners and losers. Neither proximate nor ultimate reasons for the fighting behaviour can be estimated unless the behaviour of larvae of related species is known in detail and a well-supported phylogeny of Hyperini is available. It seems quite feasible that larvae of *Hypera postica* simply do not recognize their conspecifics, and that their way of combat evolved in the presence of some unknown soft-bodied (and mostly losing) heterospecific competitor or predator. We also cannot exclude the long-term functioning of an evolutionary ratchet transforming *ad absurdum* the original simple contest competition into deathly combats.

The above conclusions apply to the less-known *Brachypera vidua* as well. Combativeness of its larvae in cultures is apparently associated with and enhanced by their solitary way of life in the field.
This study detects a previously unknown behaviour of this well-known serious pest. Future studies including even a potential interspecific combat behaviour and/or experiments in the field testing the results gained in the laboratory may elucidate this behaviour. Its recognition may also be important for the maintenance of laboratory cultures of various curculionid species.

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Note
1. The youngest instar (L1) of *B. vidua* has been never seen in the field in spite of great efforts to find it. Disregarding the incompetence of the collector as a reason, there could be two objective explanations of this: (a) life of L1 in a different microhabitat than that occupied by L2–4a, e.g. hypogeic life, or reversal to endophagy as in *Hypera nigrirostris* (Fabricius, 1775) (Skuhrovec 2005b); or (b) occurrence of L1 in the fall and hibernation of this instar, as is the case with *Brachypera zoilus* (Scopoli, 1763) (Miller 1956).

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