

Scientific Note

First record of *Trichopoda ypiranga* (Dios & Nihei, 2017) (Diptera: Tachinidae) parasitizing *Diceraeus melacanthus* (Dallas, 1851) (Hemiptera: Pentatomidae)

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Abstract. *Trichopoda ypiranga* (Dios & Nihei, 2017) (Diptera: Tachinidae) is a parasitoid of adult stink bugs and represents a promising natural enemy for integrated pest management programs. The natural occurrence of *T. ypiranga* parasitizing adults of *Diceraeus melacanthus* (Dallas, 1851) (Hemiptera: Pentatomidae) was investigated in croplands in the mid-north region of Mato Grosso, Brazil, from October 2021 to February 2025. Forty-three samples were collected from soybean, cowpea, millet, sesame, and weeds. In total, 7,754 stink bugs were collected, of which 703 were parasitized, resulting in an overall parasitism rate of 9.06%. The parasitism rate ranged from 1.04% to 30.83%, with the highest rates observed between March and May, particularly in millet (30.8%) and sesame (17.0%) crops. The most abundant parasitoid species was *T. ypiranga*, accounting for approximately 84% of emergences, with consistent records throughout the sampling period. Other species, such as *Cylindromyia brasiliiana* (Guimarães, 1983), *Gymnocyttia* sp., and *Phasia* sp. (Diptera: Tachinidae), were less frequently observed. Despite the widespread presence of *T. ypiranga*, the parasitism rate was considered moderate, potentially influenced by intensive insecticide use in the region. These findings highlight the ecological relevance of *T. ypiranga* and reinforce its potential role in biological control strategies within integrated pest management programs.

Keywords: Stink bug parasitism, green-belly stink bug, integrated pest management, biological control, parasitoid of adult.

Stink bugs are significant pests affecting annual crops in the Neotropical region, causing yield losses and challenging pest management strategies (Schaefer & Panizzi 2000). In Brazil, double-cropping systems, where soybean is followed by maize, are common. In this system, the stink bug *Diceraeus melacanthus* (Dallas, 1851) (Hemiptera: Pentatomidae) has shown remarkable adaptability and has become a relevant pest, challenging crop productivity (Saldanha et al. 2024). This species infests soybean fields from the vegetative stage until maize cultivation, causing severe injury to maize seedlings even in low infestation levels (Istchuk et al. 2023).

The main control strategy for stink bugs in Brazil is chemical control using broad-spectrum insecticides, such as pyrethroids, neonicotinoids, and organophosphates (Tuelher et al. 2018). However, there is a growing emphasis on integrated pest management and the benefits of biological control (Sosa-Gómez et al. 2020; Bueno et al. 2021). A diverse community of natural enemies, alongside stink bug pests, has been documented in key soybean-producing countries (Bueno et al. 2023). These natural enemies play a crucial role in soybean agroecosystems, influencing pest management and crop yield.

Egg parasitoids (Hymenoptera) and parasitoids of adult stink bugs (Diptera and Hymenoptera) represent promising groups for biological control against pest species (Zerbino & Panizzi 2019). While research has focused on egg parasitoids, natural parasitism of adult stink bugs by tachinid flies and hymenopteran parasitoids remains less explored but shows potential for integrated pest management in soybean systems (Agostinetto et al. 2018; Fernández et al. 2024). Adult parasitoids, particularly tachinid flies such as *Cylindromyia brasiliiana* (Guimarães, 1983) and some species of *Trichopoda* Berthold, 1827, *Gymnocyttia* Brauer & von Berganstamm, 1893 (Diptera: Tachinidae), parasitize several stink bug species in soybean fields, with parasitism

rates influenced by host species, landscape structure, and insecticide use (Aquino et al. 2019; Anderson et al. 2020; Aquino et al. 2024; Fernández et al. 2024). Although parasitism rates of adult stink bugs are lower than those of egg parasitoids, they increase in areas with reduced insecticide application (Aquino et al. 2019), highlighting the importance of conservation practices. Using adult stink bug parasitoids, either alone or in combination with egg parasitism, may be more effective at reducing pest population growth compared to egg parasitism alone (Abram et al. 2020).

Understanding the dynamics of natural parasitism in *D. melacanthus* adults is crucial for developing sustainable pest management strategies. These studies provide insights into ecological interactions between pests and natural enemies, informing conservation and augmentative biological control programs that can reduce reliance on chemical insecticides and promote pest suppression (Tillman et al. 2023). By integrating knowledge of egg and adult parasitoids, researchers can enhance the effectiveness of biological control and contribute to more resilient agroecosystems.

To investigate these dynamics, 43 samplings of *D. melacanthus* were conducted between October 2021 and February 2025, each lasting two hours, across nine counties in the mid-northern region of Mato Grosso, Brazil. Collections were carried out in soybean, cowpea, pearl millet, sesame, and associated weeds (Tab. S1, Supplementary online material). The stink bugs were sampled by direct capture on plants, transported to the laboratory, and kept at 25 ± 2 °C, relative humidity of 70%, and a photophase of 14 hours. Initial parasitism assessment was done through visual inspection, identifying parasitoid eggs on the stink bugs' tegument. The insects were individually placed in cages and fed with a natural diet (Pereira et al. 2007). Cages were monitored daily for parasitoid emergence, with cotton disks provided

for pupal development. Pupae had remained in controlled conditions until adults emerged and were sent for identification. Adult parasitoid specimens were identified based on the literature (Guimarães 1976; Dios & Nihei 2017). The examined material is deposited in the Diptera Laboratory, Museu de Zoologia of the University of São Paulo (USP), São Paulo, Brazil. The study analyzed parasitism rates, species frequency, and monthly variations in emergence. A total of 7,754 individuals of *D. melacanthus* were collected, of which 703 were parasitized, corresponding to a 9.06% parasitism rate. The parasitism rate ranged from 1.04% to 30.83%, showing significant fluctuations across sampling. From 2022 to 2024, the highest number of parasitized stink bugs occurred in soybean crops in February ($n=151$), with an average parasitism rate of 8.4%. The highest parasitism rates were observed between March and May, during collections in cowpea, sesame, and millet. Peak parasitism was observed in May, in millet and sesame crops, when about 25% of collected individuals were parasitized (Fig. 1).

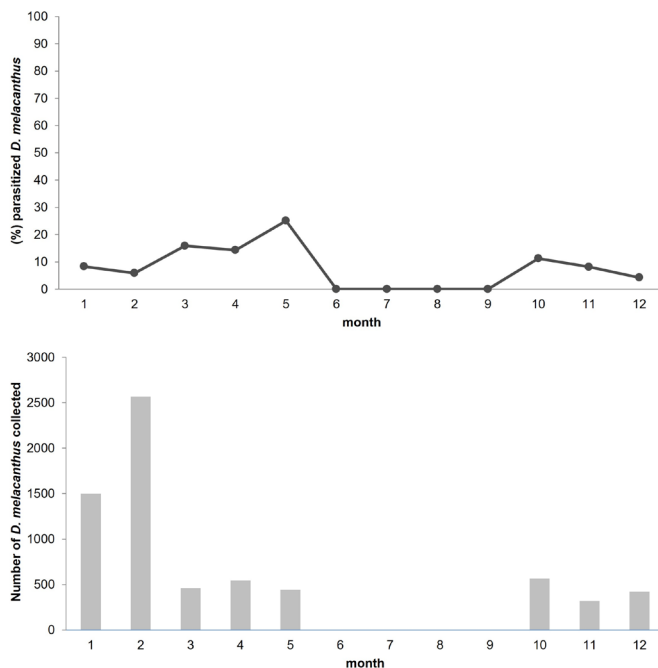


Figure 1. Average percentage of parasitized *Diceraeus melacanthus* (Dallas, 1851) (Hemiptera: Pentatomidae) adults and total *D. melacanthus* adults sampled throughout the months in the mid-northern region of Mato Grosso, based on consolidated data from 2022–2024.

This region predominantly cultivates soybeans during the summer (September to February) and engages in double-cropping with maize (February to June). This succession of crops favors the occurrence of *D. melacanthus*, since both are hosts of this stink bug. After the soybean harvest, insects often take shelter in crop residues or weeds in the cultivated areas, then move on to attack the maize seedlings. During the fallow period, adult stink bugs enter diapause and resume activity with the new soybean crops in summer. This information is relevant as the study revealed significant variability in stink bug parasitism rates across soybean cultivation, with observed values ranging from 2% to 23%. This variation included sampling at different times throughout the crop cycle, including weeds before crop sowing, harvest, and in the post-harvest period. It was observed that the highest parasitism rate occurred at the beginning of the soybean development cycle, corroborating the results reported by Corrêa-Ferreira & Sosa-Gómez (2017).

On the other hand, higher average rates of stink bug parasitism were observed in millet (30.8%) and sesame (17%) cultivation areas. The findings indicate that these crops might create beneficial conditions for parasitoid activity, potentially due to the presence of food sources, shelter, a favorable microclimate, or reduced interference from agrochemicals (Tillman et al. 2017) since these crops are subjected to fewer pesticide sprays compared to soybean and maize, which could serve as a parasitoid reservoir for the region.

The most representative parasitoid group in this study was *Trichopoda ypiranga* (Dios & Nihei, 2017) (Diptera: Tachinidae), accounting for approximately 84% of the recorded emergences in *D. melacanthus* (Fig. 2). The activity of *T. ypiranga* was more pronounced in 2022 ($n = 116$) and 2024 ($n = 121$), indicating a consistent predominance throughout the sampling period. Other tachinid species, including *C. brasiliensis*, *Gymnoclytia* sp., and *Phasia* sp., were observed with less frequency (Fig. 3). These results indicate a strong association between *T. ypiranga* and *D. melacanthus*, likely due to the phenological synchrony of the two species, the continual availability of hosts throughout the year, and the ecological adaptability of *T. ypiranga*. In contrast, the low representation of the other species parasitizing *D. melacanthus* may be attributed to several biological factors. These may include a lower dispersal capacity, competition with *T. ypiranga*, or limited preferences and/or effectiveness in host parasitism (Dippel & Hilker 1998; Gross 1993; Iwao et al. 2001; Krupke & Brunner 2003; Stireman et al. 2006).

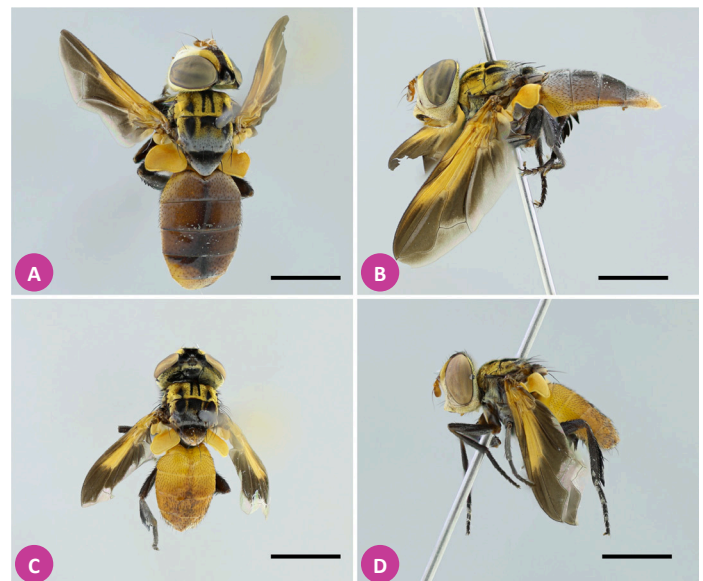


Figure 2. Adult *Trichopoda ypiranga* (Dios & Nihei, 2017) (Diptera: Tachinidae). (A–B) Male: (A) dorsal view; (B) lateral view. (C–D) Female: (C) dorsal view; (D) lateral view. Scale bar = 2 mm. Photo: R. V. P. Dios.

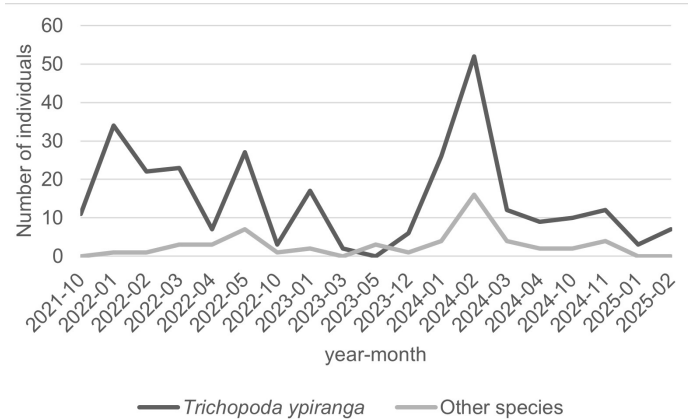


Figure 3. Monthly comparison of the number of *Trichopoda ypiranga* (Dios & Nihei, 2017) (Diptera: Tachinidae) and other parasitoid species collected from October 2021 to February 2025 from adults of *Diceraeus melacanthus* (Dallas, 1851) (Hemiptera: Pentatomidae) in the mid-northern region of Mato Grosso.

Our study is the first to report a host record for *T. ypiranga* and the first observation of *Phasia* sp. parasitizing *D. melacanthus*. A closely related species, *Trichopoda gradata* (Wiedemann, 1830), is known to parasitize two species of *Diceraeus*, *D. melacanthus* and *D. furcatus* (Fabricius, 1775), as well as a Coreidae, *Athaumastus haematicus* (Stål, 1860) (Dios & Nihei 2017). The geographic distribution of *T. gradata* is concentrated in the southern portion of South America (southern Brazil and Argentina), whereas *T. ypiranga* occurs mainly in Brazil's Southeast and Central-West regions, with a single record from

northern Argentina. Since both species exploit the same hosts but appear to be adapted to different environmental conditions, evaluating their performance under distinct climatic scenarios may be especially valuable for pest management strategies.

In the study by Corrêa-Ferreira & Sosa-Gómez (2017), 83.9% of the 161 tachinids emerging from adult *D. melacanthus* were identified as *Trichopoda* sp. (reported as *Ectophasiopsis* sp. in the original paper), whereas *Gymnocyttia* sp. and *Cylindromyia* sp. were detected much less frequently. *Gymnocyttia* sp. and *Phasia* sp. were most often associated with *Euschistus heros* (Fabricius, 1798) in soybean fields across multiple regions of Brazil (Aquino et al. 2024). Similarly, Agostinetto et al. (2018) evaluated monthly parasitism of *Diceraeus furcatus* in southern Brazil and found *T. gradata* (also reported under *Ectophasiopsis* in their study) to be the most abundant species, followed by *Cylindromyia* sp. and two *Gymnocyttia* species.

Despite the constant presence of *T. ypiranga* throughout the samples, the overall parasitism rate was relatively low (9.06%) when considering the total number of stink bugs sampled. One factor that may have contributed to this pattern is the intensive use of chemical pesticides in those areas. Several studies indicate that insecticides widely used in agricultural crops can cause not only mortality but also have sublethal effects, affecting the behavior and reproductive capacity of parasitoids (Barros et al. 2018; Stecca et al. 2018; Carvalho et al. 2019; Santos et al. 2022).

Acephate, widely used in annual crops of Mato Grosso's mid-north region, shows high toxicity to *T. ypiranga*. We observed in greenhouse tests that maize plants sprayed with half- and label-doses killed 100% of parasitoids within 24 hours (authors' unpublished data).

The frequent application of non-selective chemical products can reduce the population density of these natural enemies (Torres & Bueno 2018), decrease their ability to search for and attack hosts (Paiva et al. 2020; Stapel et al. 2000), and compromise the success of emergence (Bueno et al. 2008; Carvalho et al. 2001; Carmo et al. 2009; Costa et al. 2014). These factors highlight the importance of integrated pest management strategies that combine the rational use of insecticides with the conservation of natural enemies. According to Aquino et al. (2019), reducing insecticide applications can enhance the effectiveness of biological control agents, thereby increasing natural parasitism of adult stink bugs and, consequently, helping to regulate their populations in cultivated areas.

In general, the results obtained in this study highlight the potential of *T. ypiranga* as a biological control agent for *D. melacanthus*, especially in contexts where agricultural practices promote conditions favorable to its persistence and effectiveness in the field. Additional studies on its biology, behavior, host specificity, and selectivity to agrochemicals are essential to guide its inclusion in integrated pest management programs, both in conservative and applied forms.

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Authors' Contributions

SKAB: Conceptualization, Data curation, Investigation, Project administration; Writing – original draft, Writing – review & editing; CSO: Conceptualization, Investigation, Writing – review & editing; RVPD: Writing – review & editing; APMS: Writing – review & editing; RMP: Conceptualization; Supervision; Writing – review & editing.

Conflict of Interest Statement

The authors declare that they have no conflicts of interest related to this study.

Ethical Approval

This research did not involve human participants or vertebrate animals; therefore, ethical approval was not required.

Supplementary Material

Supplementary data for this article be accessed at doi: <https://doi.org/10.6084/m9.figshare.32415645>

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Generative AI Statement

The authors used generative artificial intelligence (ChatGPT, OpenAI) exclusively for language revision and text improvement. The authors carefully reviewed and edited the content and take full responsibility for the final version of the manuscript.

References

- Abram, P. K.; Mills, N. J.; Beers, E. H. (2020) Review: classical biological control of invasive stink bugs with egg parasitoids – what does success look like? *Pest Management Science*, 76(6): 3837–3853. doi: [10.1002/ps.5813](https://doi.org/10.1002/ps.5813)
- Agostinetto, A.; Panizzi, A. R.; Lucini, T. (2018) Monthly parasitism rate by tachinid flies and egg allocation on the body of *Dichelops furcatus*. *Florida Entomologist*, 101(1): 91–96. doi: [10.1653/024.101.0116](https://doi.org/10.1653/024.101.0116)
- Aquino, M. F. S. de; Sujii, E. R.; Borges, M.; Moraes, M. C. B.; Laumann, R. A. (2019) Diversity of stink bug adults and their parasitoids in soybean crops in Brazil: influence of a latitudinal gradient and insecticide application intensity. *Environmental Entomology*, 48(1), 105–113. doi: [10.1093/ee/nvy174](https://doi.org/10.1093/ee/nvy174)
- Aquino, M. F. S.; Sujii, E. R.; Noronha, S. E.; Borges, M.; Blassioli-Moraes, M. C.; Laumann, R. A. (2024) Influence of landscape structure on stink bug and their adult parasitoid populations on soybean culture. *BioControl*, 69(5): 519–528. doi: [10.1007/s10526-023-10233-2](https://doi.org/10.1007/s10526-023-10233-2)
- Anderson, P.; Pezzini, D.; Bueno, N.; Difonzo, C.; Finke, D.; Hunt, T.; Knodel, J.; Krupke, C.; McCornack, B.; Philips, C. R., et al. (2020) Parasitism of adult Pentatomidae by Tachinidae in soybean in the North Central region of the United States. *Journal of Insect Science*, 20(3). doi: [10.1093/jisesa/ieaa030](https://doi.org/10.1093/jisesa/ieaa030)
- Barros, E. M.; Silva-Torres, C. S. A.; Torres, J. B.; Rolim, G. G. (2018) Short-term toxicity of insecticides residues to key predators and parasitoids for pest management in cotton. *Phytoparasitica*, 46(3): 391–404. doi: [10.1007/s12600-018-0672-8](https://doi.org/10.1007/s12600-018-0672-8)
- Bueno, A. F.; Bueno, R. C. O. D. F.; Parra, J. R. P.; Vieira, S. S. (2008) Effects of pesticides used in soybean crops to the egg parasitoid *Trichogramma pretiosum*. *Ciência Rural*, 38(6): 1495–1503. doi: [10.1590/S0103-84782008000600001](https://doi.org/10.1590/S0103-84782008000600001)
- Bueno, A. F.; Panizzi, A. R.; Hunt, T. E.; Dourado, P. M.; Pitta, R. M.; Gonçalves, J. (2021) Challenges for adoption of integrated pest management (IPM): the soybean example. *Neotropical Entomology*,

- 50(1): 5–20. doi: [10.1007/s13744-020-00792-9](https://doi.org/10.1007/s13744-020-00792-9)
- Bueno, A. D. F.; Sutil, W. P.; Jahnke, S. M.; Carvalho, G. A.; Cingolani, M. F.; Colmenarez, Y. C.; Corniani, N. (2023) Biological control as part of the soybean integrated pest management (IPM): Potential and challenges. *Agronomy*, 13(10): 2532. doi: [10.3390/agronomy13102532](https://doi.org/10.3390/agronomy13102532)
- Carmo, E. L. D.; Bueno, A. F.; Bueno, R. C. O. D. F.; Vieira, S. S.; Gobbi, A. L.; Vasco, F. R. (2009) Seletividade de diferentes agrotóxicos usados na cultura da soja ao parasitoide de ovos *Telenomus remus*. *Ciência Rural*, 39(8): 2293–2300. doi: [10.1590/S0103-84782009005000188](https://doi.org/10.1590/S0103-84782009005000188)
- Carvalho, G. D.; Parra, J. R. P.; Baptista, G. D. (2001) Seletividade de alguns produtos fitossanitários a duas linhagens de *Trichogramma pretiosum* Riley, 1879 (Hymenoptera: Trichogrammatidae). *Ciência e Agrotecnologia*, 25(3): 583–591.
- Carvalho, G. A.; Grützmacher, A. D.; Passos, L. C.; Oliveira, R. L. (2019) Physiological and Ecological Selectivity of Pesticides for Natural Enemies of Insects. In: Souza, B.; Vázquez, L. L.; Marucci, R. C. (Eds.), *Natural Enemies of Insect Pests in Neotropical Agroecosystems*, p. 469–478. Springer, Cham. doi: [10.1007/978-3-030-24733-1_37](https://doi.org/10.1007/978-3-030-24733-1_37)
- Corrêa-Ferreira, B. S.; Sosa-Gómez, D. R. (2017) Percevejos e o sistema de produção soja-milho. Londrina: Embrapa Soja. Embrapa Soja, Documentos 397. <https://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/1086374>. Access on: 19.xi.2025
- Costa, M. A.; Moscardini, V. F.; Gontijo, P. C.; Carvalho, G. A.; Oliveira, R. L. de; Oliveira, H. N. de (2014) Sublethal and transgenerational effects of insecticides in developing *Trichogramma galloi* (Hymenoptera: Trichogrammatidae). *Ecotoxicology*, 23(8): 1399–1408. doi: [10.1007/s10646-014-1282-y](https://doi.org/10.1007/s10646-014-1282-y)
- Dios, R. de V. P.; Nihei, S. S. (2017) Taxonomic revision of the Neotropical genus *Ectophasiopsis* Townsend, 1915 (Diptera: Tachinidae: Phasiinae). *European Journal of Taxonomy*, 334: 1–34. doi: [10.5852/ejt.2017.334](https://doi.org/10.5852/ejt.2017.334)
- Dippel, C.; Hilker, M. (1998) Effects of physical and chemical signals on host foraging behavior of *Drino inconspicua* (Diptera: Tachinidae), a generalist parasitoid. *Environmental Entomology*, 27(3): 682–687. doi: [10.1093/ee/27.3.682](https://doi.org/10.1093/ee/27.3.682)
- Fernández, C.; Punschke, E.; Cingolani, M.; Carrizo, A.; Barakat, M.; Dios, R. de V. P.; Blengino, F.; Huarte, F.; Montero, G. (2024) Tachinids in conservation biological control of phytophagous Pentatomidae. *BioControl*, 69(5): 539–550. doi: [10.1007/s10526-024-10282-1](https://doi.org/10.1007/s10526-024-10282-1)
- Gross, P. (1993) Insect behavioral and morphological defenses against parasitoids. *Annual Review of Entomology*, 38(1): 251–273. doi: [10.1146/annurev.en.38.010193.001343](https://doi.org/10.1146/annurev.en.38.010193.001343)
- Guimarães, J. H. (1976) A revision of the genus *Cylindromyia* Meigen in the Americas South of United States (Diptera: Tachinidae). *Arquivos de Zoologia*, 27(1): 1–50. doi: [10.11606/issn.2176-7793.v27i1p1-50](https://doi.org/10.11606/issn.2176-7793.v27i1p1-50)
- Istchuk, A.; Foresti, J.; da Silva, P.; Pietrowski, V.; Pereira, R. (2023) Evaluation of damage caused by stink bug *Diceraeus melacanthus* (Dallas) and *Euschistus heros* (F.) (Heteroptera: Pentatomidae) to maize seedlings. *Australian Journal of Crop Science*, 17(2): 935–943. doi: [10.21475/ajcs.23.17.12.p4004](https://doi.org/10.21475/ajcs.23.17.12.p4004)
- Iwao, K.; Nakamura, S.; Ohsaki, N. (2001) Plant-based host preference and larval competition of the tachinid parasitoid *Epicampocera succincta*. *Population Ecology*, 43(2): 149–155. doi: [10.1007/PL00012026](https://doi.org/10.1007/PL00012026)
- Krupke, C. H.; Brunner, J. F. (2003) Parasitoids of the Conspere Stink Bug (Hemiptera: Pentatomidae) in North Central Washington and attractiveness of a host-produced pheromone component. *Journal of Entomological Science*, 38(1): 84–92. doi: [10.18474/0749-8004-38.1.84](https://doi.org/10.18474/0749-8004-38.1.84)
- Paiva, A. C. R.; Iost Filho, F. H.; Parro, E. A.; Barbosa, D. P.; Yamamoto, P. T. (2020) Do ready-mix insecticides cause lethal and sublethal effects on *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae) pupae? *Journal of Economic Entomology*, 113(3): 1227–1233. doi: [10.1093/jee/toaa031](https://doi.org/10.1093/jee/toaa031)
- Pereira, P. D. S.; Tonello, L. S.; Salvadori, J. R. (2007) Caracterização das fases de desenvolvimento e aspectos da biologia do percevejo barriga-verde *Dichelops melacanthus* (Dallas, 1851). Embrapa Trigo, Comunicado Técnico 214. <https://www.infoteca.cnptia.embrapa.br/infoteca/handle/doc/852409>. Access on: 19.xi.2025
- Saldanha, A.; Horikoshi, R.; Dourado, P.; Verejo, R.; Berger, G.; Martinelli, S.; Head, G.; Moraes, T.; Corrêa, A.; Schwertner, C. (2024) The first extensive analysis of species composition and abundance of stink bugs (Hemiptera: Pentatomidae) on soybean crops in Brazil. *Pest Management Science*, 80(8): 3945–3956. doi: [10.1002/ps.8097](https://doi.org/10.1002/ps.8097)
- Santos, L. V.; de Lima Alvarez, D.; Santos, L. M.; Prado, J. C.; Freitas Bueno, R. C. O.; Hoback, W. W. (2022) Selectivity and sub-lethal effect of pesticides on the immature and adult stages of *Telenomus podisi* (Hymenoptera: Scelionidae). *International Journal of Tropical Insect Science*, 42(2): 1731–1736. doi: [10.1007/s42690-021-00698-y](https://doi.org/10.1007/s42690-021-00698-y)
- Schaefer, C. W.; Panizzi, A. R. (2000) *Heteroptera of economic importance*. CRC Press LLC, Boca Raton.
- Sosa-Gómez, D.; Corrêa-Ferreira, B.; Kraemer, B.; Pasini, A.; Husch, P.; Vieira, C.; Martinez, C.; Lopes, I. (2020) Prevalence, damage, management and insecticide resistance of stink bug populations (Hemiptera: Pentatomidae) in commodity crops. *Agricultural and Forest Entomology*, 22(2): 99–118. doi: [10.1111/afe.12366](https://doi.org/10.1111/afe.12366)
- Stapel, J. O.; Cortesero, A. M.; Lewis, W. J. (2000) Disruptive sublethal effects of insecticides on biological control: altered foraging ability and life span of a parasitoid after feeding on extrafloral nectar of cotton treated with systemic insecticides. *Biological Control*, 17(3): 243–249. doi: [10.1006/bcon.1999.0795](https://doi.org/10.1006/bcon.1999.0795)
- Stecca, C. S.; Bueno, A. F.; Pasini, A.; Silva, D. M.; Andrade, K.; Filho, D. M. Z. (2018) Impacto de inseticidas utilizados na cultura da soja sobre o parasitoide de ovos *Telenomus podisi* (Hymenoptera: Platygasteridae). *Neotropical Entomology*, 47(2): 281–291. doi: [10.1007/s13744-017-0552-9](https://doi.org/10.1007/s13744-017-0552-9)
- Stireman, J. O.; O'Hara, J. E.; Wood, D. M. (2006) Tachinidae: evolution, behavior, and ecology. *Annual Review of Entomology*, 51: 525–555. doi: [10.1146/annurev.ento.51.110104.151133](https://doi.org/10.1146/annurev.ento.51.110104.151133)
- Tillman, G. (2017) Ecosystem-based incorporation of nectar-producing plants for stink bug parasitoids. *Insects*, 8(3): 65–24. doi: [10.3390/insects8030065](https://doi.org/10.3390/insects8030065)
- Tillman, P.; Grabarczyk, E.; Kesheimer, K.; Balusu, R. (2023) Seasonal density and natural mortality of *Halyomorpha halys* (Stål) and indigenous stink bugs (Hemiptera: Pentatomidae) in a field crop agroecosystem. *Journal of Economic Entomology*, 116(5): 1636–1648. doi: [10.1093/jee/toad159](https://doi.org/10.1093/jee/toad159)
- Torres, J. B.; Bueno, A. F. (2018) Conservation biological control using selective insecticides – a valuable tool for IPM. *Biological Control*, 126: 53–64. doi: [10.1016/j.biocontrol.2018.07.012](https://doi.org/10.1016/j.biocontrol.2018.07.012)
- Tuelher, E.; Silva, É.; Rodrigues, H.; Hirose, E.; Guedes, R.; Oliveira, E. (2018) Area-wide spatial survey of the likelihood of insecticide control failure in the neotropical brown stink bug *Euschistus heros*. *Journal of Pest Science*, 91(2): 849–859. doi: [10.1007/s10340-017-0949-6](https://doi.org/10.1007/s10340-017-0949-6)
- Zerbino, M. S.; Panizzi, A. R. (2019) The underestimated role of pest pentatomid parasitoids in Southern South America. *Arthropod-Plant Interactions*, 13(5): 703–718. doi: [10.1007/s11829-019-09703-1](https://doi.org/10.1007/s11829-019-09703-1)