

Bedellia somnulentella (Lepidoptera: Bedelliidae): record of a new host and predator in Atlantic Forest biome in Minas Gerais state, Brazil

Rodrigo Almeida Pinheiro (✉ bio.rodrigopinheiro@gmail.com)

UFVJM: Universidade Federal dos Vales do Jequitinhonha e Mucuri <https://orcid.org/0000-0001-5642-5065>

Maria Jéssica dos Santos Cabral

Samuel Cunha Oliveira Giordani

Marcos Magalhaes de Souza

José Cola Zanuncio

José Barbosa dos Santos

Marcus Alvarenga Soares

Short Report

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Abstract

Bedellia somnulentella Zeller, 1847 (Lepidoptera: Bedelliidae), microlepidoptera leafminer of plants of the Convolvulaceae family, has *Ipomoea batatas* as its main commercial host. The distribution of this insect is cosmopolitan, with importance in different regions of the world. The aim was to report the occurrence of *B. somnulentella* in a new biome and host plant and a predator of this pest in the state of Minas Gerais, Brazil. This damaged *Distimake dissectus* var. *edentatus* (Convolvulaceae) plants in the Atlantic Forest biome in the municipality of Viçosa, Minas Gerais state, Brazil. *Agelaia vicina* Saussure, 1854 (Hymenoptera: Vespidae) fed on *B. somnulentella* caterpillars and pupae. The record of this insect on *D. dissectus* var. *edentatus* expands the number of its hosts in a new biome. The record of the predator *A. vicina* increases the number of enemies and reinforces the importance of Vespidae to reducing populations of the leaf miner *B. somnulentella* in the field.

Introduction

Trade and human mobility facilitate insect biological invasions, threatening the world agriculture (Desneux et al., 2022). *Bedellia somnulentella* Zeller, 1847 (Lepidoptera: Bedelliidae), a microlepidoptera leaf miner, reached pest status with cosmopolitan distribution (Steyn et al., 2020). This moth was first collected in South America in Peru (NHM, 1914) and its second report was more than a century later in Diamantina, Minas Gerais state in southeastern Brazil (Santos et al., 2018).

Bedellia somnulentella feeds on herbaceous, shrubby and arboreal plants of the families Brassicaceae, Convolvulaceae, Salicaceae and Solanaceae (Parenti, 2000; NHM, 2022). The caterpillars of this insect cause intense defoliation of host plants and a single one can injury more than one leaf simultaneously, mainly of plants of the Convolvulaceae family (Steyn et al., 2020; Ayabe et al., 2016).

Leaf mines are characteristic damage by *B. somnulentella* larvae, causing defoliation and reducing the photosynthetic area of plants, such as *Ipomoea batatas*, its main host, of economic importance and commercialized *in natura*, industrialized and as fodder for animals (Santos et al., 2018).

Information about the area of occurrence, new hosts and biological control agents are important to managing *B. somnulentella*, an invasive insect with high dispersion potential. The objective was to report the occurrence of *B. somnulentella* and a new host plant and predator insect in a different biome (Atlantic Forest) in Brazil.

Materials and methods

Injuries on a plant of the Convolvulaceae family were observed in the herbarium of the Federal University of Viçosa (UFV) in Viçosa, Minas Gerais state, Brazil (20°45'.23.4972 S; 42°52'26.6916" W 648 m.a.l.s.) by caterpillars, which were collected from these plants and placed in Falcon tubes (100 mL) and in cages with glass lids and organza mesh (33×33×33) receiving, as food, leaves of the host plant until the pre-pupa stage to obtaining its adults. Pupae were also collected.

Photographs of the flower, leaf and sepal of the insect's host plant were sent to Dr. John Wood of the Department of Plant Sciences, University of Oxford, South Park Road, Oxford, OX1 3RB, UK and Dra. Ana Rita Giraldes Simões of the Department of Biology, Ghent University and visiting professor at the Royal Botanic Gardens, Kew Richmond, Surrey TW9 3AE, United Kingdom.

The wings of five specimens of the moth, obtained from rearing, were clarified and compared with those of the Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM), identified as *B. somnulentella* by the taxonomist Dr. Vitor Osmar Becker of the Department of Zoology of the Universidade de Brasília (UNB).

Vespidae preyed on *B. somnulentella* caterpillars and pupae on the host plant. A specimen of this insect was collected and sent to Dr. Marcos Magalhães de Souza, Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais, Brazil, for identification.

The host plant, specimens of *B. somnulentella* and the predator were photographed using a Canon EOS Rebel 850D camera.

The moth specimens were deposited in the entomological collection of the UFVJM without an identification number. The specimen of Vespidae was deposited in the Biological Collection of Social Wasps (CBVS) of IFSULDEMINAS, Campus Inconfidentes, under identification number 10365 – 2022.

Results

Bedellia somnulentella injured *Distimake dissectus* var. *edentatus* (Convolvulaceae) plants in the Atlantic Forest biome, municipality of Viçosa, Minas Gerais state, Brazil (**Fig. 1**). The collected caterpillars and pupae completed the biological cycle by feeding on *D. dissectus* var. *edentates* leaves. This plant is annual, but *B. somnulentella* was observed from April to May of 2022 and 2023. Plants of *Ipomoea alba*, *Ipomoea batatas*, *Ipomoea cairica* and *Ipomoea purpurea* were present in the area, but only those of *D. dissectus* var. *edentatus* were injured (**Fig. 2 -a, b, c, d and e**).

The Vespidae preyed on *B. somnulentella* caterpillars on *D. dissectus* var. *edentates* and pupae of this insect on the abaxial part of the leaves of this plant, in the municipality of Viçosa, Minas Gerais state, Brazil and it was identified as *Agelaia vicina* Saussure, 1854 (Hymenoptera: Vespidae) (**Fig. 2 - f**).

Discussion

The record of *B. somnulentella* on plants of *D. dissectus* var. *edentatus* increases the number of hosts of this insect, which damaged *I. batatas*, its main host, in the regions of the North (Salinas), Vale do Jequitinhonha (Diamantina) and South (Lavras) of Minas Gerais state, Brazil (Santos et al., 2020). In addition, this insect has been reported on the weeds *Calystegia pubescens*, *Calystegia sepium*, *Convolvulus althaeoides*, *Convolvulus arvensis*, *Convolvulus sicularis*, *Convolvulus tricolor*, *Ipomoea aquatica*, *Ipomoea batatas*, *Ipomoea purpurea* and *Ipomoea somnulenta* (Convolvulaceae), *Salix* sp.

(Salicaceae), *Sisymbrium irium* (Brassicaceae) and *Solanum melongena* (Solanaceae) (Parenti, 2000; NHM, 2022; Cabral et al., 2022). However, *B. somnulentella* prefers plants of the genus *Ipomoea* (Convolvulaceae).

Adaptation to different hosts favors the dispersal of the leaf miner *B. somnulentella* as a cosmopolitan insect pest, as reported for *Tuta absoluta* Meyrick, 1917 (Lepidoptera: Gelechiidae), another microlepidoptera with similar characteristics and wide distribution in the world on commercial plants such as *Solanum lycopersicum* and *Solanum tuberosum*, weeds such as *Solanum nigrum* (Solanaceae) and on plants of the Amaranthaceae, Convolvulaceae, Fabaceae and Malvaceae families (Desneux et al., 2010, Abbes et al., 2016; Bawin et al., 2016).

Bedellia somnulentella established itself in a new area, with a high altitude, tropical climate, and an average annual temperature of 19°C, varying between 14°C and 32°C. In other municipalities, where the insect has been reported, the variations of this variable is low, such as Diamantina, with 19°C, Lavras, 20°C and Salinas, 23°C (Santos et al., 2020 b).

The record of *A. vicina* preying on *B. somnulentella* larvae and pupae increases the number of natural enemies of this family for this pest. *Agelaia vicina* occurs mainly in the Southeast and some South Brazil areas has been reported to occur in the states of Minas Gerais and São Paulo, Southeast, and Rio Grande do Sul, South Brazil (Souza et al., 2020). The colony of this insect can host 1 million of cells, with horizontal and uniform combs. The offspring of this insect are usually near the center of the colony, with the peripheral cells empty as a protection against parasitoids and predators. The wasp builds its colonies in different places, including exposed ones (Jeanne, 1995; Zuchi, 1995; Oliveira et al., 2010). Individuals of *A. vicina* forages between 6 AM to 6 PM with specific areas of foraging. The diet of this insect comprises at least species of ten insect orders and spiders, but mainly Lepidoptera (Brigatte et al., 2011; Southon et al., 2019).

Protonectarina sylveirae Saussure, 1854 (Hymenoptera: Vespidae) fed on *B. somnulentella* caterpillars and pupae in a plantation of *I. batatas* in the municipality of Diamantina, Minas Gerais state, Brazil (Cabral et al., 2024). *Horismenus cupreus* Ashmead, 1894 (Hymenoptera: Eulophidae) and *Conura* sp. (Hymenoptera: Chalcididae) parasitized thousands of *B. somnulentella* pupae (Santos et al., 2021; 2022), individually, in Brazil. Other natural enemies of *B. somnulentella* caterpillars include *Apanteles bedelliae* Viereck, *Apanteles tapatapaoanus* Fullaway, 1946, *Apanteles ingenuoides* Papp, 1971, *Protapanteles triangulator* Wesmael, 1837 and other Hymenoptera of the genera *Apanteles* spp. and *Microplitis* spp. (Hymenoptera: Braconidae), in addition to the parasitoids *Diadegma elisha* and *Nythobia koizumii* (Hymenoptera: Ichneumonidae), *Spilochalcis albifrons* (Hymenoptera: Chalcididae) and *Elachertus* spp., *Horismenus* spp., and *Sympiesis* spp. (Eulophidae) (CABI et al., 2022), probably pupal and solitary parasitoids. Natural enemies of miners are numerous, such as predatory bugs of the families Anthocoridae, Geocoridae, Miridae, Nabidae and Pentatomidae (Desneux et al., 2010, Zappala et al., 2013; Calvo et al., 2016), species of the family Vespidae and others arthropods such as ants, earwigs, ground

beetles, lacewings, ladybugs, predatory mites, spiders and thrips, (Picanço et al., 1998; Desneux et al., 2010; Zappala et al., 2013).

Conclusions

The record of *B. somnulentella* on *D. dissectus* var. *edentatus* plants increases the number of hosts of this species in a new biome (Atlantic Forest) and the predator *A. vicina*, the enemies of this pest, reinforcing the importance of Vespidae in the biological control of *B. somnulentella* larvae in the field.

Declarations

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References

1. Abbes K, Harbi A, Elimem M, Hafsi A, Chermiti B (2016) Bioassay of three solanaceous weeds as alternative hosts for the invasive tomato leafminer *Tuta absoluta* (Lepidoptera: Gelechiidae) and insights on their carryover potential. *Afr. Entomol.* 24: 334-342. <https://doi.org/10.4001/003.024.0334>.
2. Ayabe Y, Hijii N (2016) Avoidance of parasitoid attack is associated with the spatial use within a leaf by a lepidopteran leafminer. *Entomol. Exp. Appl.* 161: 39-49. <https://doi.org/10.1111/eea.12492>.
3. Bawin T, Dujew D, Backer L, Francis F, Verheggen FJ (2016) Ability of *Tuta absoluta* (Lepidoptera: Gelechiidae) to develop on alternative host plant species. *Can. Entomol.* 148: 434–42. <https://doi.org/10.4039/tce.2015.59>.
4. Brigatte P, Cury Y, Souza BM, Baptista-Saidemberg NB, Saidemberg DM, Gutierrez VP, Palma MS (2011) Hyperalgesic and edematogenic effects of peptides isolated from the venoms of honeybee (*Apis mellifera*) and neotropical social wasps (*Polybia paulista* and *Protonectarina sylveirae*). *Amino Acids* 40: 101–111. <http://dx.doi.org/10.1007/s00726-010-0512-8>. PMID:20177946.
5. Cabral MJS, Silva IM, Pinheiro RA, Santos M.M., Soares MA., Plata-Rueda A, Castro, BMC., Silva, WM, Silva, ES, Zanoncio, JC (2024). *Protonectarina sylveirae* (Hymenoptera: Vespidae): first report preying *Bedellia somnulentella* (Lepidoptera: Bedelliidae) in Brazil. *Braz J Biol.* 84: 256779. <http://dx.doi.org/10.1590/1519-6984.256779>.

6. Cabrera-Asencio I, Segarra-Carmona AE, Vélez AL (2008) *Bedellia somnulentella* (Zeller) (Lepidoptera: Lyonetiidae): una nueva plaga de la batata/*Ipomoea batatas* (L.)] introducida en Puerto Rico. The J Agri Univ Puerto Rico, 92: 115-118. <https://doi.org/10.46429/jaupr.v92i1-2.2627>.
7. Calvo FJ, Lorente MJ, Stansly PA, Belda JE (2012) Preplant release of *Nesidiocoris tenuis* and supplementary tactics for control of *Tuta absoluta* and *Bemisa tabaci* in greenhouse tomato. Entomol. Exp. Appl. 143:111–19. <https://doi.org/10.1111/j.1570-7458.2012.01238.x>.
8. Compendium. Invasive Species. *Bedellia somnulentella* (sweet potato leafminer), 2022. <https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.8761>.
9. Desneux N, Han P, Mansour R, Arnó J, Brévault T, Campos MR, Chailleux A, Guedes RNC, Karimi J, Konan KAJ, Lavoie AV, Luna GM, Perez-Hedo M, Urbaneja A, Verheggen FJ, Zappalà L, Abbes K, Ali A, Bayram Y, Cantor F, Cuthbertson AGS, Vis RD, Erler F, Firake DM, Haddi K, Hajjar MJ, Ismoilov K, Jaworski CC, Kenis M, Liu HT, Madadi H, Martin T, Mazih A, Messelink GJ, Mohamed AS, Nofemela RS, Oke A, Ramos C, Ricupero M, Roditakis E, Shashank PR, Wan FH, Wang MH, Wang S, Zhang YB, Biondi A (2022) Integrated pest management of *Tuta absoluta*: practical implementations across different world regions. J Pest Sci. 95:17–39. <https://doi.org/10.1007/s10340-021-01442-8>.
10. Desneux N, Wajnberg E, Wyckhuys KAG, Burgio G, Arpaia S, Narváez-Vasquez CA, González-Cabrera J, Ruescas DC, Tabone E, Frandon J, Pizzol J, Poncet C, Cabello T, Urbaneja A (2010) Biological invasion of European tomato crops by *Tuta absoluta*: ecology, geographic expansion and prospects for biological control. J. Pest Sci. 83:197–215. <https://doi.org/10.1007/s10340-010-0321-6>.
11. Jeanne RL (1995) Foraging in social wasps: *Agelaia* lacks recruitment to food (Hymenoptera: Vespidae). J Kansas Entomol Soc. 64: 279–289.
12. NHM. A database of the world's lepidopteran host plants. London, UK: Natural History Museum (London). 2022.
13. Oliveira OAL, Noll FB, Wenzel JW (2010). Foraging behavior and colony cycle of *Agelaia vicina* (Hymenoptera: Vespidae; Epiponini). J Hym. Res. 19: 4–11.
14. Parrella MP, Kok LT (1977) The Development and reproduction of *Bedellia somnulentella* on Hedge Bindweed and Sweet Potato. Ann Entomol Soc Am. 70:925–928. <https://doi.org/10.1093/aesa/70.6.925>.
15. Picanço MC, Leite GLD, Guedes RNC, Silva EA (1998) Yield loss in trellised tomato affected by insecticidal sprays and plant spacing. Crop Prot. 17: 447-452. [https://doi.org/10.1016/S0261-2194\(98\)00040-4](https://doi.org/10.1016/S0261-2194(98)00040-4).
16. Pimentel D, Lach L, Zuniga R, Morrison D (2000) Environmental and economic costs of nonindigenous species in the United States. BioSci, 50: 53-65, 2000. [https://doi.org/10.1641/0006-3568\(2000\)050\[0053:EAECON\]2.3.CO;2](https://doi.org/10.1641/0006-3568(2000)050[0053:EAECON]2.3.CO;2).
17. Santos MM, Cabral MJS, Abreu CM, Silva IM, Costa VA., Demolin-Leite, GL, Pires EM, Soares MA (2022). *Horismenus cupreus* (Hymenoptera: Eulophidae) parasitizing *Bedellia somnulentella* (Lepidoptera: Bedelliidae) in *Ipomoea batatas*. Braz J Biol. 82: e262626. <https://doi.org/10.1590/1519-6984.262626>. <https://doi.org/10.1653/024.101.0224>

18. Santos MM, Gomes GN, Pinto TAA, Silva IM, Leite GLD, Soares MA (2020) Geographic distribution of the *Ipomoea batatas* (Convolvulaceae) pest, *Bedellia somnulentella* (Zeller) (Lepidoptera: Bedelliidae), in Minas Gerais state, Brazil. J Plant Dis Protect 128:617–621. <https://doi.org/10.1007/s41348-020-00390-2>.
19. Santos MM, Silva RS, Soares MA, Lopes EMG, Shabani F (2022) Global risks of *Bedellia somnulentella* (Lepidoptera: Bedelliidae) invasion: a modeling exercise using a mechanistic model. CLIMEX. Theo Appl Climat. 149:401–411. <https://doi.org/10.1007/s00704-022-04051-2>.
20. Santos MM, Soares MA, Silva IM, Caldeira ZV, Abreu CM, Souza MW, Silva AA, Zanuncio JC, Castro BMC (2021) Life history of *Bedellia somnulentella* (Lepidoptera: Bedelliidae) feeding on *Ipomoea batatas* (Solanales: Convolvulaceae) leaves and survey of parasitoids in Brazil. J Econ Entomol 114:1631–1637. <https://doi.org/10.1093/jee/toab078>.
21. Santos MM, Soares MA, Silva IM, Fontes PCR, Zanuncio JC (2018) First record of the sweet potato pest *Bedellia somnulentella* (Lepidoptera: Bedelliidae) in Brazil. Fla Entomol 101:315–316. <https://doi.org/10.1653/024.101.0224>.
22. Southon RJ, Fernandes OA, Nascimento FS, Sumner S (2019). Social wasps are effective biocontrol agents of key lepidopteran crop pests. *Proc Royal Soc B: Biol Sci.* 286: 20191676. <https://doi.org/10.1098/rspb.2019.1676>.
23. Souza MM, Teofilo-Guedes GS, Milani L R, Souza ASB, Gomes PP (2020) Social wasps (Vespidae: Polistinae) from the brazilian atlantic forest. Sociobiology. 67: 1-12. <https://doi.org/10.13102/sociobiology.v67i1.4597>.
24. Steyn LAI, Geertsema H, Malan AP, Addison PA (2020) Review of leaf-mining insects and control options for their management, with special reference to *Holocacista capensis* (Lepidoptera: Heliozelidae) in vineyards in South Africa. S Afri J Eno Vit. 41: 218–232. <http://dx.doi.org/10.21548/41-2-4081>.
25. Zappalà L, Biondi A, Alma A, Al-Jboory IJ, Arnò J, Bayram A, Chailleux A, El-Arnaouty A, Gerling D, Guenaoui Y, Shaltiel-Harpaz L, Siscaro G, Stavrinides M, Tavella L, Aznar RV, Urbaneja A, Desneux N (2013) Natural enemies of the South American moth, *Tuta absoluta*, in Europe, North Africa and Middle East, and their potential use in pest control strategies. J. Pest Sci. 86: 635–647. <https://doi.org/10.1007/s10340-013-0531-9>.
26. Zucchi R (1995) *Agelaia vicina*, a swarm-founding Polistine with the largest colony size among wasps and bees (Hymenoptera: Vespidae)". J. New York Entomol. Soc. 103: 129–137.

Figures

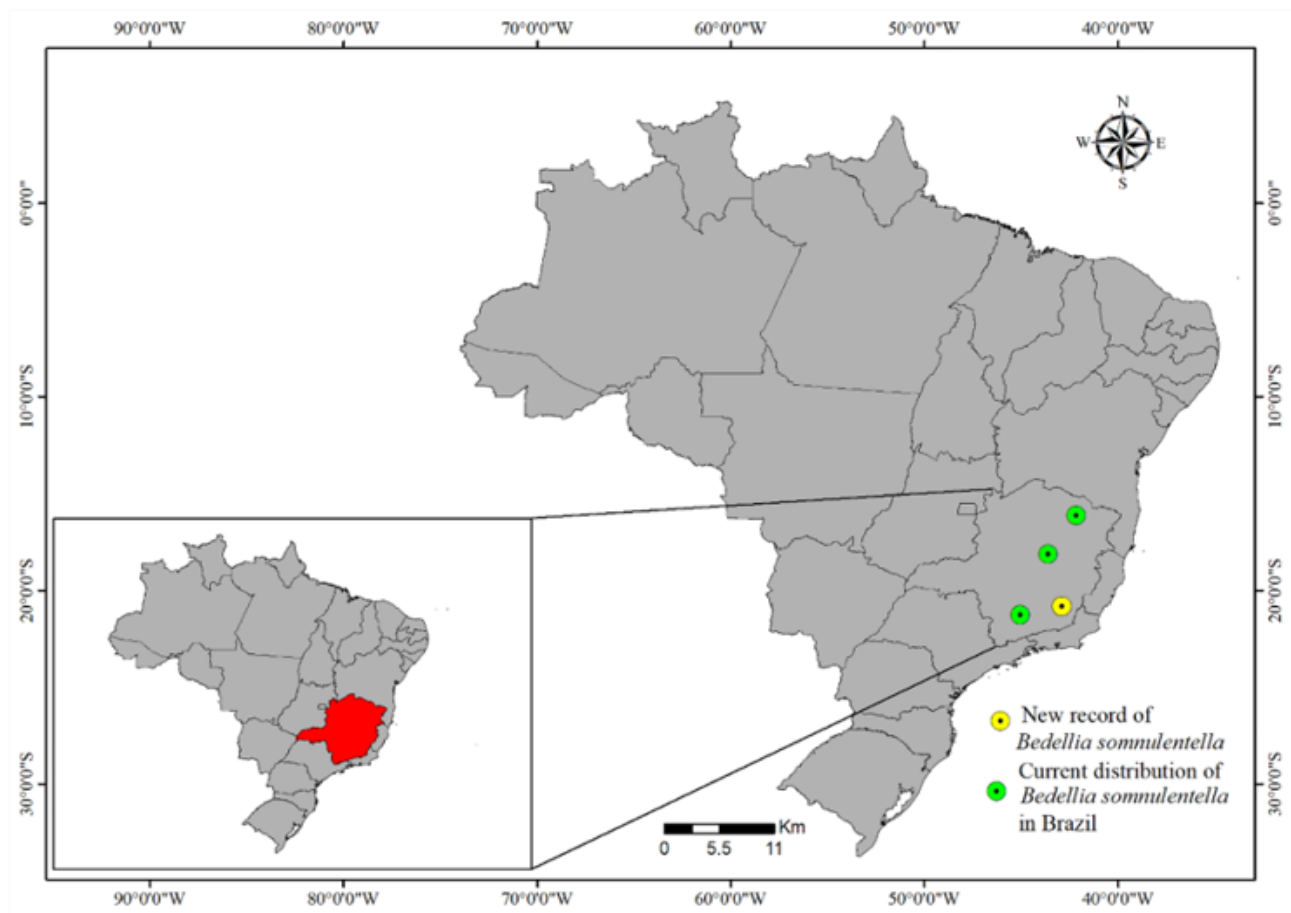


Figure 1

New occurrence of *Bedellia somnulentella*(Lepidoptera: Bedelliidae) in the sub-region of Zona da Mata in Viçosa, Minas Gerais state, Brazil and its current distribution in this country.



Figure 2

Plants of *Distimake dissectus* var. *edentatus* injured by *Bedellia somnulentella* (A, B): last instar caterpillar (C), pupa (D) and adult of *B. somnulentella* (E); *Agelaia vicina*, predator of *B. somnulentella*(F).