









# New records, host, and plant symptoms description of the recently reported *Delia sanctijacobi* (Bigot) (Diptera: Anthomyiidae) in Brazil

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**Abstract.** *Delia* Robineau-Desvoidy, composed of flies popularly known as root maggot flies, is a diverse genus with unclear delimitation. It comprises polyphagous species and some important agricultural pests. *Delia sanctijacobi* (Bigot) is native to South America, occurring in Argentina, Brazil, Chile, Peru, and Uruguay; the larvae are commonly known as "potato worms" and have been misidentified as *Delia platura* (Meigen) in Brazil. *Delia sanctijacobi* attacks the seeds and seedlings of several plants of commercial importance. We present new geographic records of *D. sanctijacobi* in Brazil and describe the damage caused by their larvae on commercial bean and onion in Paraná and Santa Catarina between 2019-2022.

**Keywords:** pest insects; Neotropical Region; plant-insect interaction; root maggot flies; South America.

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### Article Full Open Access

Anthomyiidae (Diptera, Calypttratae) includes approximately 2,000 species and 40 genera distributed worldwide (MICHELSEN 2010). *Delia* Robineau-Desvoidy, also known as root maggot flies, is a diverse, non-monophyletic genus with unclear delimitation. The included species are found mainly in subalpine and subarctic areas of the Palearctic and Nearctic regions (GRIFFITHS 1986; GOMES *et al.* 2021). *Delia* species are polyphagous, and some are considered important agricultural pests of commercially important plants, mainly cruciferous (GRIFFITHS 1986; GOINGUENÉ & STÄDLER 2006; SAVAGE *et al.* 2016; MERAZ-ÁLVAREZ *et al.* 2020; TEJEDA-REYES *et al.* 2023). In Brazil, there are four agricultural pest species of this genus, *Delia antiqua* Meigen, *Delia platura* Meigen, *Delia radicum* Linnaeus, and the recently reported *Delia sanctijacobi* (Bigot), which the larvae are commonly known as "potato worms" and the females lay their eggs near cuts in potatoes or seeds (SILVA *et al.* 1968; HAMITY & ROMAN 1987; GOMES *et al.* 2022).

The identification of some *Delia* species is difficult, particularly of females and larvae (SAVAGE *et al.* 2016). The main diagnostic characteristics for species identification are male characters, particularly in the terminalia (GRIFFITHS 1993). Even when males are available, some species like *D. sanctijacobi* and *D. platura* are difficult to recognize because their genitalia is very similar (GOMES *et al.* 2022).

*Delia sanctijacobi* is native to South America, occurring in Argentina, Brazil, Chile, Peru, and Uruguay (GOMES *et al.* 2022). GRIFFITHS (1993) recorded this species in Alaska (USA), which seem to be caused by accidental introduction. This species attacks the seeds of Amaryllidaceae: garlic (*Allium sativum* L.); Asteraceae: sunflower (*Helianthus annuus* L.); Brassicaceae: cauliflower (*Brassica oleracea* L. var. *gemmifera*); Curcubitaceae: melon (*Cucumis melo* L.), pumpkin (*Cucurbita* sp.); Fabaceae: bean (*Phaseolus* sp.); Linaceae: flax (*Linum usitatissimum* L.); Poaceae: corn (*Zea mays* L.), wheat (*Triticum aestivum* L.); and, as well as the seedlings of Amaryllidaceae: onion (*Allium cepa* L.); Brassicaceae: broccoli (*Brassica oleracea* L. var. *italica*); and Solanaceae: eggplant (*Solanum melongena* L.), tomato (*Solanum lycopersicum* L.) (MOLINARI 1942; QUINTANILLA 1969; HAMITY & ROMAN 1987; GRIFFITHS 1993; GOMES *et al.* 2022).

Bean, cabbage, garlic and onion are economically and socially important in the states of Paraná and Santa Catarina. Together, it accounts for about 35%, 25%, 23%, and 11% of the Brazilian production, respectively. Paraná is one of the most important producers of beans and Santa Catarina is the most important onion producer (IBGE 2021; SALVADOR & PEREIRA 2021; EPAGRI 2022). Due to the significant damage that *D. sanctijacobi* can cause on different plants of agricultural importance and the need to better understand the distribution of this species, herein we present new records for *D. sanctijacobi* in Brazil and describe the damage caused by *D. sanctijacobi* larvae in commercial bean and onion from Paraná and Santa Catarina (Brazil) in 2019-2022.

## MATERIAL AND METHODS

The bean and onion plants showing symptoms of larval infestation by *Delia* were collected from fields and packed in plastic trays for pupation and emergence of the adults. The adult specimens obtained from garlic (in 2021) were collected with Moericke traps. The adults were identified based on morphological characters presented by GOMES et al. (2022). The specimens were deposited in the Entomological Collection Pe. Jesus Santiago Moure (DZUP), Department of Zoology, Universidade Federal do Paraná. The examined material is presented in Table 1.

The measurements of egg (n=5), larvae (n=8), and adults (n=6) of some samples collected in the field were made using an ocular micrometer attached to a Zeiss Stemi 305 stereomicroscope. The distributional map was produced using the software QGIS 2.18.28 (available on: <https://www.qgis.org/en/site/>).

## RESULTS

All larvae collected from onion, bean, and cabbage in 17 municipalities of the states of Paraná and Santa Catarina were identified as *D. sanctijacobi*. Due to a population outbreak that occurred on onion, several observations were made in the field on the infestation of this crop.

We observed larvae attacking cabbage, garlic, and onion plants in the states of Paraná and Santa Catarina in 2017 and 2019. In 2020, 2021 and 2022, several population outbreaks of *D. sanctijacobi* were recorded infesting on onion (Table 1). In the field, several observations were made regarding the

period of occurrence. In 2022, we collected a sample of bean plants (*Phaseolus vulgaris* L.) also attacked by *D. sanctijacobi* (Figure 2B), which presented similar symptoms to those observed in onions (Figure 1), described below.

The females of *D. sanctijacobi* oviposited above or below the soil, close to the plants, often through injuries caused by the process of transplanting seedlings. Eggs deposited up to 10 cm deep were collected (Figure 1A). The postures are isolated or grouped in up to 5 eggs. The eggs are similar in color and shape to rice grains, being white, with an cylindrical shape, and are about 1.7 mm (1.5–1.8 mm) long (Figure 1D).

*Delia sanctijacobi* larvae are yellowish-white, 6-8 mm long (Figure 1B and E). The pupae remain under the soil close to the plants roots at a depth of approximately 5-10 cm (Figure 1C and F). We observed that decomposing plant material, discarded onion seedlings and/or seedling pruning, apparently attract these flies and trigger oviposition (Figure 1G).

The first larval instars of *D. sanctijacobi* eat the roots of the host plants (Figure 2A and B). Then, it perforates the plants crown and bore the stem, causing damages similar to borer pests blocking the passage of water and nutrients into the plant (Figure 2C and D). Onion and bean seedlings present the follow symptoms when are infested by *D. sanctijacobi*: yellowing and drying of the leaves and, subsequently, death of the plant (Figure 2E), which cause a reduction of the crop density in the field.

**Table 1.** Material examined and known hosts of *Delia sanctijacobi* in Paraná and Santa Catarina (Brazil). PR = Paraná. SC = Santa Catarina. M = Moericke. I = Immature collected from infested plant.

Locality	Coordinates	Altitude (m)	Date	Hosts	Methods	N (M-Male: F-Female)
PR, Araucária	-25.71139, -49.43706	966.7	24.viii.2019	<i>Allium sativum</i> L.	I	35M:22F
PR, Contenda	-25.74372, -49.56728	884.2	11.viii.2020	<i>Allium sativum</i> L.	I	Immatures
PR, Irati	-25.42956, -50.66096	938.3	24.vi.2020	<i>Allium cepa</i> L.	I	3M:0F
PR, Palmeira	-25.42953, -50.13286	905.6	28.viii.2019	<i>Brassica oleracea</i> L. var. <i>capitata</i>	I	4M:5F
PR, Palmeira	-25.4317, -50.13673	907.4	24.vi.2021	<i>Allium cepa</i> L.	I	2M:1F
PR, União da Vitória	-26.22104, -51.10797	767.5	25.viii.2017	<i>Brassica oleracea</i> L. var. <i>capitata</i>	I	3M:1F
SC, Aurora	-27.36999, -49.66162	527.5	07.viii.2022	<i>Phaseolus vulgaris</i> L.	I	7M:9F
SC, Atalanta	-27.42187, -49.67879	465.1	05.viii.2021	<i>Allium cepa</i> L.	I	3M:7F
SC, Aurora	-27.38783, -49.56573	619.1	01.ix.2020	<i>Allium cepa</i> L.	I	27M:19F
SC, Aurora	-27.34769, -49.56765	711.5	06.vii.2021	<i>Allium cepa</i> L.	I	8M:10F
SC, Bom Retiro	-27.69248, -49.47924	747.7	27.vii.2021	<i>Allium cepa</i> L.	I	5M:5F
SC, Caçador	-26.68283, -50.97631	1116	21.vii.2020	<i>Allium sativum</i> L.	I	7M:5F
SC, Caçador	-26.69667, -50.99027	1046.4	01.ix.2021	<i>Allium sativum</i> L.	M	10M:15F
SC, Curitibaanos	-27.20022, -50.71008	890.3	25.viii.2021	<i>Allium sativum</i> L.	M	10M:13F
SC, Fraiburgo	-27.145867, -50.82387	964.5	25.viii.2021	<i>Allium sativum</i> L.	M	2M:5F
SC, Frei Rogério	-27.21557, -50.73376	832.6	25.viii.2021	<i>Allium sativum</i> L.	M	11M:14F
SC, Imbuia	-27.46161, -49.4076	800.6	03.ix.2020	<i>Allium cepa</i> L.	I	1M:1F
SC, Imbuia	-27.46161, -49.4076	800.6	13.viii.2021	<i>Allium cepa</i> L.	I	2M:2F
SC, Ituporanga	-27.44431, -49.54949	660.7	11.ix.2020	<i>Allium cepa</i> L.	I	19M:21F
SC, Ituporanga	-27.45795, -49.54216	635.9	02.viii.2021	<i>Allium cepa</i> L.	I	18M:16F
SC, Lebon Régis	-26.90767, -50.72007	1040.1	10.viii.2021	<i>Allium sativum</i> L.	M	40M:58F
SC, Urubici	-27.9314, -49.67135	882.5	04.x.2020	<i>Allium cepa</i> L.	I	8M:4F
SC, Vidal Ramos	-27.4272, -49.44813	788.6	23.viii.2019	<i>Allium cepa</i> L.	I	5M:3F
SC, Vidal Ramos	-27.4272, -49.44813	788.6	20.vii.2021	<i>Allium cepa</i> L.	I	5M:7F



**Figure 1. (A–E)** Biological stages of *Delia sanctijacobi*; (A) eggs on the soil; (B) larvae attacking onion stem; (C) pupa (red arrow) on soil; (D) egg, detail; (E) larva, detail; (F) pupa, detail; (G) seedling bed with residues of onion crop.

Adults are 5 mm (4.8–5.2 mm) long, greyish, and have hyaline wings (see Figure 3, [GOMES et al. 2022](#)). The adults are generally not very active. It flies slowly, especially in the early hours of the morning. On windless sunny days, it is possible to see males and females moving freely over the onion beds.

Transplanted crops had a higher incidence of flies than onions that had been directly sown in the field. A total of 80% of the onion-cultivated areas in Santa Catarina contain plants transplanted from bare roots ([EPAGRI 2013](#)).

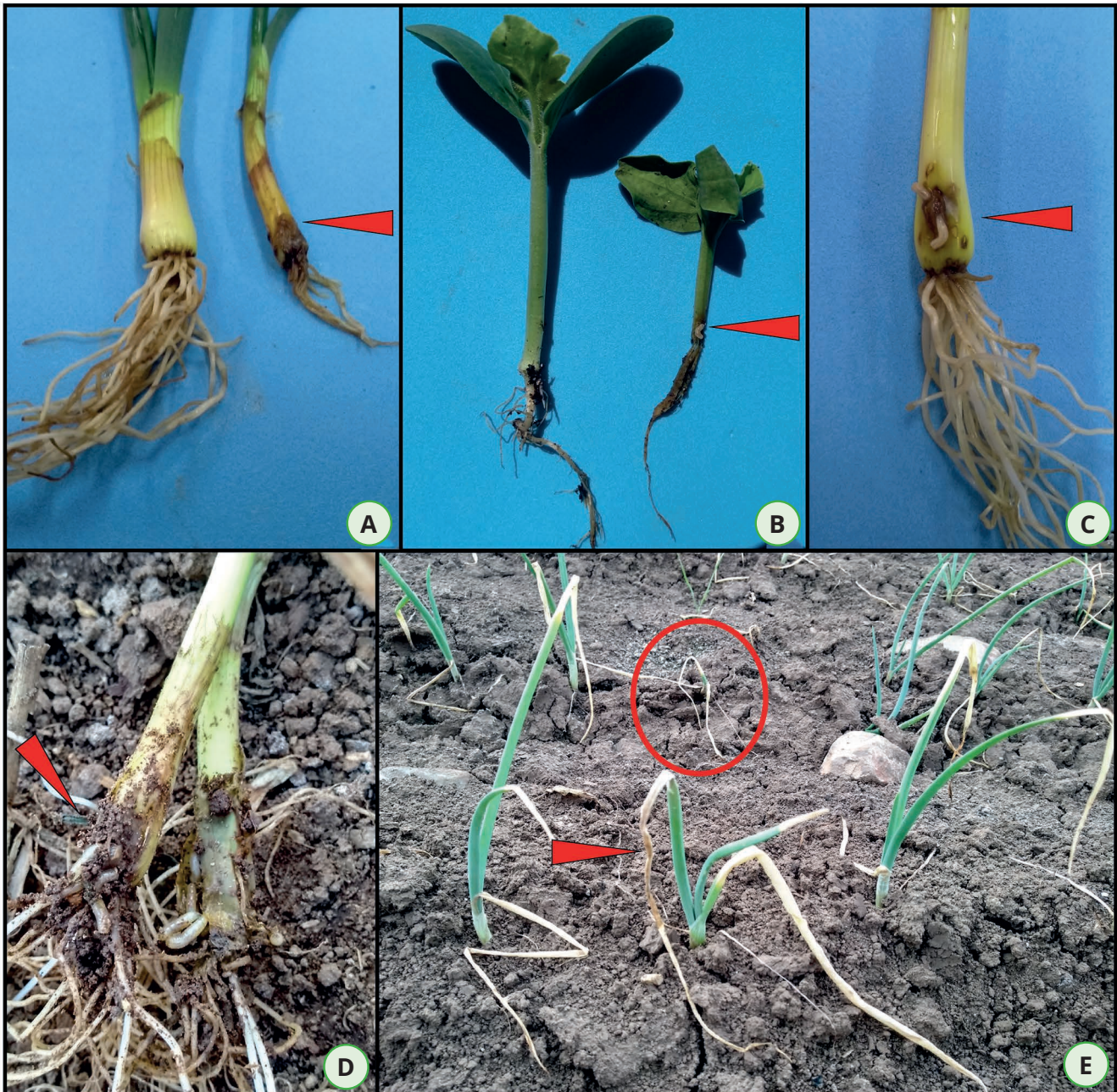
## DISCUSSION

In Brazil, there are reports of outbreaks of *Delia* populations in onion from 1989-1990. Also, there are occasional outbreaks in the growing seasons in newly transplanted onion seedlings, which is why these flies are commonly known as "seedbed flies" in the Alto Vale do Itajaí region, Santa Catarina ([BOFF 1991](#); [GONÇALVES 2006](#); [GEREMIAS 2022](#)). There are also reports of outbreaks in beans, corn and soybean in the state of Rio Grande do Sul from 1976-1977 ([LINK & COSTA 1981](#)). In all cases, the species responsible for

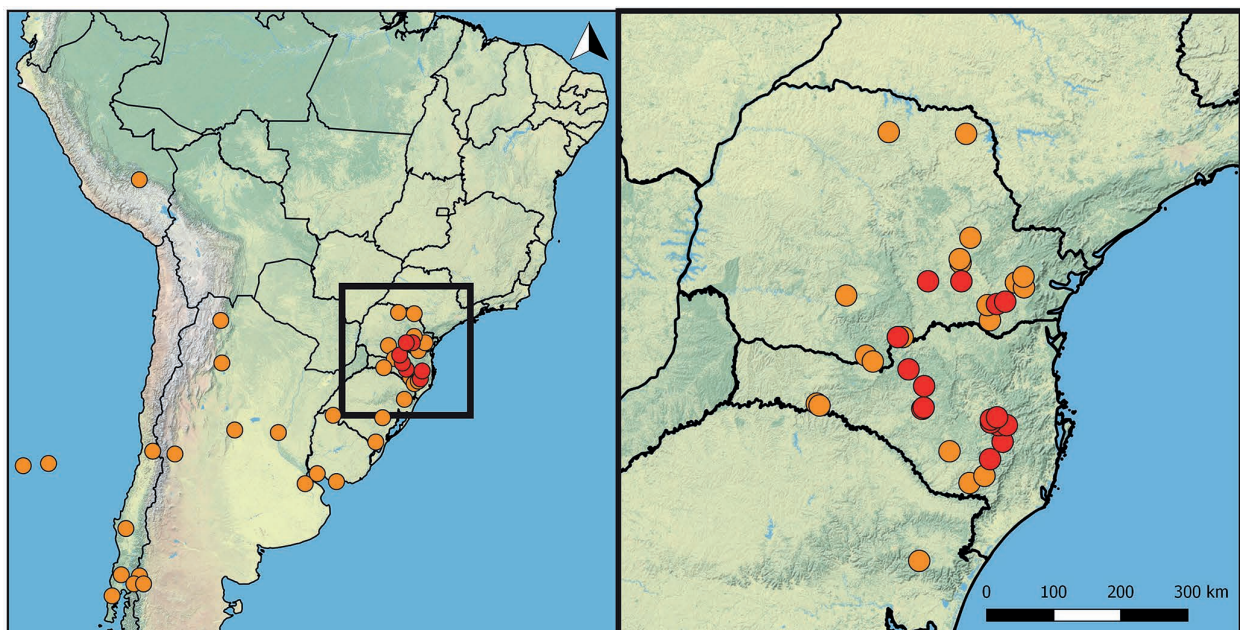
the outbreaks was identified as *D. platura*. However, since *D. platura* and *D. sanctijacobi* are very similar, it is possible that these specimens were misidentified as *D. platura*, at least in some cases, as discussed by [GOMES et al. \(2022\)](#).

In Argentina, *D. sanctijacobi* was recorded on different host plants: alfalfa (*Medicago sativa* L.), oat (*Avena sativa* L.), wheat (*Triticum* sp.), bean (*Vicia faba* L.), potato (*Solanum tuberosum* L.), beet (*Beta vulgaris* L.), and lettuce (*Lactuca sativa* L.) ([HAMITY & ROMAN 1987](#)). This species attacks the seeds of corn, bean (cotyledons), pumpkin, melon, wheat, flax, garlic, sunflower, and cauliflower (*Brassica* cv.), and the seedlings of tomato, eggplant, and onion ([MOLINARI 1942](#); [QUINTANILLA 1969](#); [GRIFFITHS 1993](#)). In Brazil, *D. sanctijacobi* was only formally recorded in broccoli (*B. oleracea* var. *italica*) collected in União da Vitória, Paraná (Figure 3) ([GOMES et al. 2022](#)). Here we presented the first reliable record of *D. sanctijacobi* in bean (*P. vulgaris*) and onion (*A. cepa*) in Brazil, and new records of this species in Paraná and Santa Catarina (Figure 3).

Although *D. sanctijacobi* infests garlic, bean, cabbage and onion, significant damages were only verified in onion. Three



**Figure 2.** Symptoms of attack by *Delia sanctijacobi*. (A) healthy onion plant and attacked by larvae of *D. sanctijacobi* (red arrow); (B) healthy bean plant (*Phaseolus vulgaris*) and attacked by larvae of *D. sanctijacobi* (red arrow); (C - D) onion plant perforated by larvae causing boring of the seedling; (E) onion plant, first symptoms of the attack, leaves wilting and tips yellowish (arrow); and dead plant (red circle).



**Figure 3.** Geographic distribution of *Delia sanctijacobi* (Bigot, 1885). Symbols: orange circles = literature records; red circles = new records.

*Delia* species are commonly associated with this crop: *D. antiqua*, *D. florilega* (Zetterstedt) and *D. platura* (FINCH 1989; TEJEDA-REYES *et al.* 2023). In USA, *D. antiqua* is an important pest of onion in temperate areas, and its management has relied on prophylactic insecticide applications during planting and/or seed treatment (NAULT *et al.* 2006). However, in Santa Catarina (Brazil), onion is primarily cultivated by transplanting seedlings (EPAGRI 2013). There are currently no pesticides in Brazil for the control of *D. sanctijacobi*. Alternative pest management methods have been recommended to farmers, such as not transplanting over seedling production beds, not hurting the seedlings during transplanting, using well-decomposed organic matter, and eliminating crop residues. Even though damages caused by *D. platura* on different plants of economic interest in Brazil have been recorded (LINK & COSTA 1981; BOFF 1991; GONÇALVES 2006), it is probably *D. sanctijacobi* (GOMES *et al.* 2022).

Here, we present the first detailed description of the damage caused by *D. sanctijacobi* in onion and bean in Brazil. This species has economic importance due to the potential of reduction in the productivity of cultivated areas, and there is only few information about its occurrences in the literature. Studies about the distribution and damages of pest species as *D. sanctijacobi* are necessary to better understand the behaviour and to better control the damages of this species.

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### REFERENCES

- Boff, MIC, 1991. Ocorrência de *Delia platura* (Meigen, 1826) (Diptera, Anthomyiidae) em cebola, no estado de Santa Catarina. *Anais da Sociedade Entomológica do Brasil*, 20: 461-462.
- Epagri, 2013. Sistema de produção para a cebola: Santa Catarina. Epagri. Florianópolis, Sistema de Produção.
- Epagri, 2022. Síntese anual da Agricultura de Santa Catarina. Available on: <[https://docweb.epagri.sc.gov.br/website\\_cepa/publicacoes/Sintese\\_2021\\_22.pdf](https://docweb.epagri.sc.gov.br/website_cepa/publicacoes/Sintese_2021_22.pdf)> [Access: 26.ix.2023].
- Finch, S, 1989. Ecological considerations in the management of *Delia* pest species in vegetable crops. *Annual Review of Entomology*, 34: 117-137.
- Geremias, LD, PAS Gonçalves & JC Lins Júnior, 2022. Danos de mosca-da-raiz, *Delia* sp., em cebola. Available on: <<https://publicacoes.epagri.sc.gov.br/nt/article/view/1547>>. [Access: 10.iv.2023].
- Gomes, LRP, DS Souza & CJB de Carvalho, 2021. First insights into the evolution of neotropical anthomyiid flies (Diptera: Anthomyiidae). *Systematics and Biodiversity*, 19: 724-737. DOI: <https://doi.org/10.1080/14772000.2021.1914765>
- Gomes, LRP, MAC Zawadneak, MCV Costa-Ribeiro, TM Jarek & CJB de Carvalho, 2022. Integrating morphology and DNA barcode for identification of *Delia sanctijacobi* (Diptera: Anthomyiidae): new host and new records in South America. *Arthropod Systematics & Phylogeny*, 80: 511-522. DOI: <https://doi.org/10.3897/asp.80.e82831>
- Gonçalves, PAS, 2006. Moscas-da-cebola - (Diptera), *Delia platura* (Meigen) (Anthomyiidae); *Pseudosciara pedunculata* (Enderlein) (Sciaridae), pp. 174-181. *In: Wordell-Filho JA, E Rowe, PAS Gonçalves, JF Debarba, P Boff & LF Thomazelli (Eds.). Manejo fitossanitário na cultura da cebola. Florianópolis, Epagri.*
- Gouinguéné, SP & E Städler, 2006. Oviposition in *Delia platura* (Diptera, Anthomyiidae): the role of volatile and contact cues of bean. *Journal of Chemical Ecology*, 32: 1399-1413. DOI: <https://doi.org/10.1007/s10886-006-9058-3>
- Griffiths, GCD, 1986. Relative abundance of the root maggots *Delia radicum* (L.) and *D. floralis* (Fallén) (Diptera; Anthomyiidae) as pests of canola in Alberta. *Quaestiones entomologicae*, 22: 253-260.
- Griffiths, GCD, 1993. Anthomyiidae [part]. pp. 1417-1632. *In: Griffiths GCD (Ed.). Flies of the Nearctic Region*, 8: 10. Stuttgart, E. Schweizerbart.
- Hamity, MGA & LEN Roman, 1987. Anthomyiidae de interes agricola en distintos cultivos de altura de Jujuy. Aparicion Estacional y mayor abundancia. *Revista de la Sociedad Entomológica Argentina*, 44: 411-418.
- IBGE, 2021. Instituto Brasileiro de Geografia e Estatística. Produção de cebola. Available on: <<https://www.ibge.gov.br/explica/producao-agropecuaria/cebola/>>. [Access: 24.iii.2023].
- Link, D & EC Costa, 1981. Ocorrência e danos causados por larvas de *Delia platura* (Meigen, 1826) (Diptera: Anthomyiidae) em algumas culturas de importância agrícola. *Revista do Centro de Ciências Rurais*, 11: 57-62.
- Meraz-Álvarez, R, N Bautista-Martínez, CP Illescas-Riquelme, H González-Hernández, JM Valdez-Carrasco & J Savage, 2020. Identification of *Delia* spp. (Robineau-Desvoidy) (Diptera, Anthomyiidae) and its cruciferous hosts in Mexico. *ZooKeys*, 964: 127-141. DOI: <https://doi.org/10.3897/zookeys.964.53947>
- Michelsen, V, 2010. Anthomyiidae (Anthomyiid Flies). pp. 1271-1276. *In: Brown BV, A Borkent, JM Cumming, DM Wood, NE Woodley & M Zumbado (Eds.). Manual of Central American Diptera. Vol 2. Ottawa, National Research Council Press.*
- Molinari, OC, 1942. *Entomologia Agrícola*. pp. 1-575. Mendoza, D'Accurzio.
- Nault, BA, RW Straub & AG Taylor, 2006. Performance of novel insecticide seed treatments for managing onion maggot (Diptera: Anthomyiidae) in onion field. *Crop Protection*, 25: 58-65. DOI: <https://doi.org/10.1016/j.cropro.2005.03.020>
- Quintanilla, RH, 1969. Principales causas adversas de origen animal, en los cultivos de la República Argentina, pp. 35-52. *Actas de las I Jornadas Fitosanitarias Argentinas*. Buenos Aires, Universidad Nacional La Plata.
- Salvador, CA & JR, Pereira, 2021. Prognóstico Agropecuário - Feijão, 13: 1-11. Available on: <[https://www.agricultura.pr.gov.br/sites/default/arquivos\\_restritos/files\\_documento/2022-01/fejiao.pdf](https://www.agricultura.pr.gov.br/sites/default/arquivos_restritos/files_documento/2022-01/fejiao.pdf)>. [Access: 25.ix.2023].
- Savage, J, A Fortier, F Fournier & V Bellavance, 2016. Identification of *Delia* pest species (Diptera: Anthomyiidae) in cultivated crucifers and over other vegetable crops in Canada. *Canadian Journal of Arthropod Identification*, 29: 1-40. DOI: <https://doi.org/10.4039/Ent83109-5>
- Silva, AGDA, CR Gonçalves, DM Galvão, JL Gonçalves, J Gomes, M do Nascimento Silva & L de Simoni, 1968. Quarto Catálogo dos Insetos que Vivem nas Plantas do Brasil seus Parasitos e Predadores. Rio de Janeiro, Ministério da Agricultura.
- Tejeda-Reyes, MA, AG Rojas-Rosales, CP Illescas-Riquelme & A Hernández-Juárez, 2023. Incidence of *Delia platura* (Meigen) (Diptera: Anthomyiidae) in onion and scallion crops in Mexico. *Florida Entomologist*, 105: 319-320. DOI: <https://doi.org/10.1653/024.105.0410>

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