Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Notes and Comments

# First Record of *Cactoblastis cactorum* Berg, 1885 (Lepidoptera: Pyralidae) in *Hylocereus lemairei* (Hook.) Britton & Rose and *H. costaricensis* (F.A.C. Weber) Britton & Rose (Cactaceae) in Brazil

A. T. Hoshino[a]*, H. G. Androcioli[b], J. H. Caviglione[b], P. A. M. Auler[b] and A. O. Menezes-Junior[a]

[a] *Universidade Estadual de Londrina – UEL, Departamento de Agronomia, Laboratório de Entomologia, Londrina, PR, Brasil*

[b] *Instituto de Desenvolvimento Rural do Paraná - IAPAR-EMATER, Área de Proteção de Plantas, Laboratório de Entomologia, Londrina, PR, Brasil*

The dragon fruit *Hylocereus* (A. Berger) Britton & Rose (Cactaceae), is an endemic genus of the subtropical and tropical regions of the Americas (Le Bellec et al., 2006). The four most cultivated species of dragon fruit in the world are *H. undatus* (Haw.) Britton & Rose, *H. costaricensis* (F.A.C Weber) Britton & Rose, *H. monacanthus* (Lem.) Britton & Rose, and *H. megalanthus* (K. Schumann ex Vaupel) Ralf Bauer (Ortiz-Hernández and Carrillo-Salazar, 2012). Currently, dragon fruit is cultivated in Oceania, Americas, Europe, and Asia (Mizrahi and Nerd, 1999; Nerd et al., 2002; Nobel and De la Barrera, 2002). In Brazil, the amount of dragon fruit commercially produced rose from 103 tons in 2009 to 953 tons in 2018, indicating an increasing market for this fruit (PROHORT, 2019).

Dragon fruit production may be constrained by about 65 potential pest species belonging to eight arthropod orders (Drew and Hancock, 1994; Hoa et al., 2006; Delgado et al., 2010; Ramírez-Delgadillo et al., 2011; USDA, 2011; Marques et al., 2012; Ortiz-Hernández and Carrillo-Salazar, 2012; Choi et al., 2013; DAWR, 2017; Jaya, 2018; Carrillo et al., 2019). The members of the order Lepidoptera appear to have a secondary role as dragon fruit pests, as only seven species in five families have been reported as pests: *Cactoblastis cactorum* Berg, 1885 and *Ephestia elutella* (Hübner, 1796) (both Pyralidae), *Conogethes* sp. Meyrick, 1884 and *Maracayia chlorisalis* (Walker, 1859) (both Crambidae), *Conopomorpha* sp. Meyrick, 1885 (Gracillaridae), *Orgyia* sp. Ochsenheimer, 1810 (Lymantriidae) and *Spodoptera litura* (Fabricius, 1775) (Noctuidae) (USDA, 2011; Ortiz-Hernández and Carrillo-Salazar, 2012; Choi et al., 2013; Galette, 2015).

The genus *Cactoblastis* Ragonot 1901, (Pyralidae) comprises five species of South American origin (Mann, 1969; McFadyen, 1985). The larvae of the species feed on cacti of the genera *Cylindropuntia* (Engelm.) F. M. Knuth, *Cereus* Mill., *Eriocereus* (A.Berger) Riccob., and *Opuntia* Mill. (Zimmermann et al., 2004). *Cactoblastis cactorum,* endemic to northern Argentina, southern Brazil, Paraguay, and Uruguay (Mann, 1969; McFadyen, 1985), is the best known species. Owing to its use in biological control of *Opuntia* spp., it has the widest geographical distribution and has been introduced into Australia, South Africa, and Hawaii (Zimmermann et al., 2001). Intentional or accidental introduction of this moth in different regions has increased its geographical distribution and promoted its adaptation to new cactus species (Hight et al., 2002; Briano et al., 2012), putting at risk several species native to the USA, Caribbean, and Mexico (Zimmermann et al., 2001; Bravo-Avilez et al., 2019). Currently, *C. cactorum* occurs in countries in the Neotropical, Nearctic, Ethiopian, and Australian regions (Stiling, 2002). There are only two reports, both in the Nearctic region, on the association between *C. cactorum* and the genus *Hylocereus* in field conditions, presented by Galette (2015); however, they are based on personal communication of unpublished data. In this study, we report the occurrence of *C. cactorum* attacking dragon fruit plants. This is the first record of *C. cactorum* as a potential pest of *Hylocereus lemairei* (Hook.) Britton & Rose and *H. costaricensis* in Brazil.

Larvae of *C. cactorum* were observed to attack dragon fruit plants during the year 2019 in multiple localities in Paraná State: Centenário do Sul (22º44'41"S; 51º36'12"W), Ibiporã (23º19'46"S; 51º02'19"W), Rolândia (23º12'37"S; 51º22'00"W), Umuarama (23º59'10"S; 53º39'32"W), and Paranavaí (23º05'47"S; 52º26'18"W). In the first two locations, the plants were kept in a garden (two to eight plants), whereas the other locations were commercial plantations containing up to 200 plants of *H. costaricensis*, *H. lemairei*, and *H. undatus*. The adults obtained were identified by Lepidoptera specialist Dr. Vitor Osmar Becker. Voucher specimens are deposited in the entomology collection at the Instituto de Desenvolvimento Rural do Paraná - IAPAR-EMATER (IDR-Paraná) in Londrina, PR.

Field surveys of dragon fruit were performed, verifying that *C. cactorum*-inflicted injuries begin with small yellowish portions in the cladodes (Figure 1A). These yellowish portions increase in size and acquire brown tones with small circular holes plugged by a thin layer of "silk" with nearby debris and dried frass (Figure 1B). Subsequently, the cladodes become translucent due to the consumption of the internal tissue, leaving only the vascular bundle and epidermis (Figure 1C). These observations are similar

*e-mail: hoshinoagro@gmail.com
Received: May 14, 2020 – Accepted: July 17, 2020

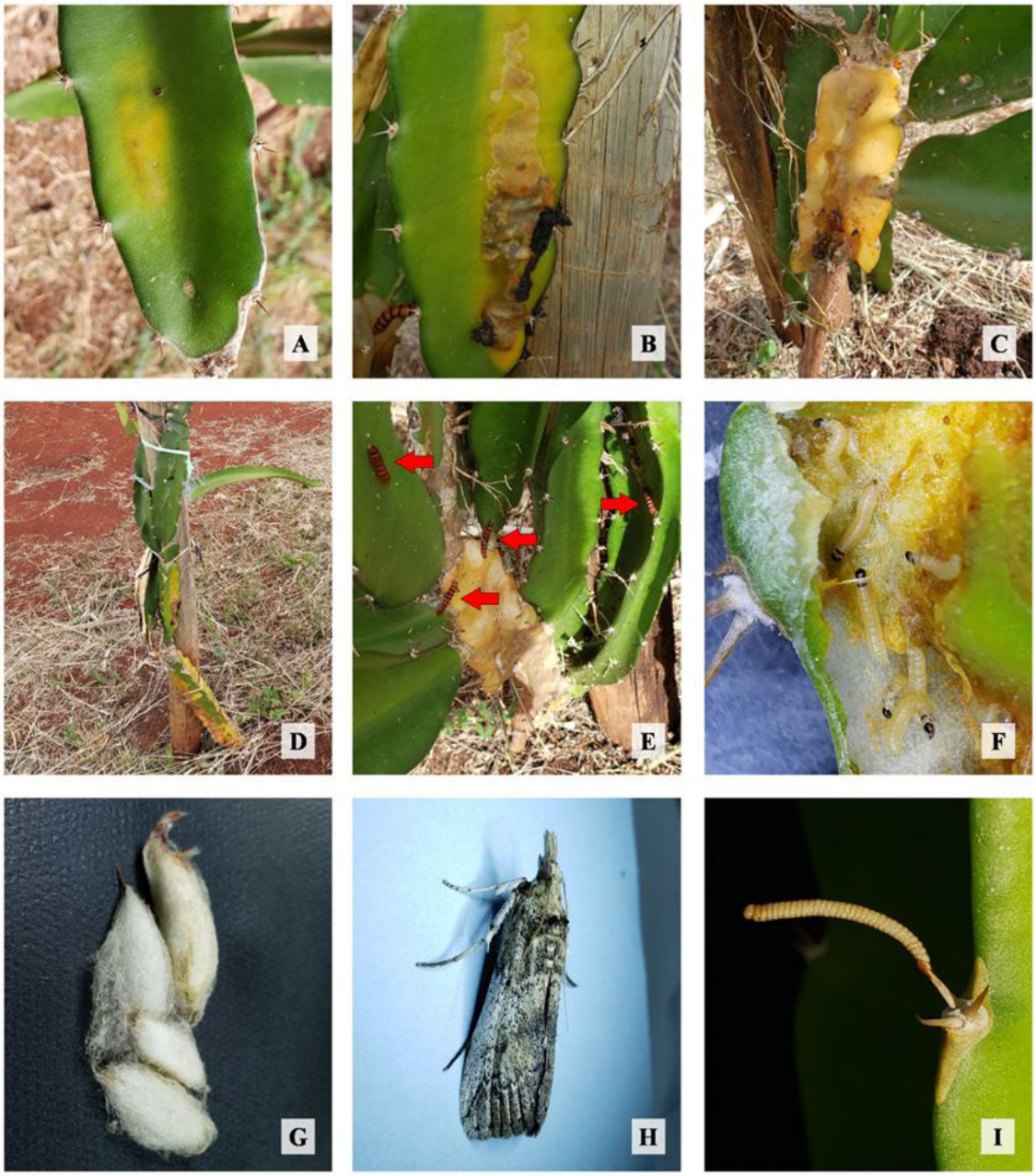


**Figure 1.** Dragon fruit damage, larvae and adult of *Cactoblastis cactorum* Berg, 1885. (A) Initial lesion on cladode; (B) Advanced stage lesion with necrotic areas and debris plus dried frass; (C) Remains of completely consumed cladode with only the epidermis and vascular system remaining; (D) Plant basis with lesion; (E) Migration of 5$^{th}$ and 6$^{th}$ instar caterpillars to upper cladodes; (F) Second instar caterpillars consuming the cladode; (G) Cocoons; (H) Adult moth; (I) Eggs stick on a cladode thorn.

to those by Mann (1969) on cacti of the genus *Opuntia*. The *C. cactorum* attack begins in cladodes close to the ground (Figure 1D), with up to 40 caterpillars involved (Figure 1F). After consumption of the inner tissues of the lower cladode, the caterpillars in advanced instars migrate externally and randomly to the upper cladodes of the plant (Figure 1E, indicated by red arrow), with an average of five fifth instar caterpillars per damaged cladode. In commercial sites, with more than one species of dragon fruit, damage was observed only on *H. lemairei* and *H. costaricensis*, whereas *H. undatus* plants were not damaged, even in intercropping systems. Overall, 32% of plants belonging to *H. costaricensis* had damaged cladodes, with an average of three damaged cladodes per plant. When the attack occurred on young plants, they did not develop and did not produce fruits (personal communication from producers). However, the reduced production among plants in full production was not quantified, and further studies are needed to investigate this issue.

In a preliminary free-choice laboratory test, the caterpillars collected from commercial areas fed on both cladodes of *H. costaricensis* and *H. undatus* until they reached adulthood, corroborating the report of Galette (2015), which indicates that *C. cactorum* has the ability to use two species of dragon fruit as a host plant. The absence of damage on *H. undatus* in commercial areas is most likely due to the oviposition non-preference of *C. cactorum* adults.

In the laboratory, second instar caterpillars (Figure 1F) from Ibiporã fed on *H. lemairei* cladodes. Eighty-three days later, the caterpillars formed puparia with silk threads (Figure 1G), and the adults emerged 24 days afterward (Figure 1H). They laid "egg sticks" on the thorns of cladodes of *H. lemairei*, using it as their host plant (Figure 1I). The number of eggs per "egg stick" ranged from 16 to 69, and this variation was also reported by Mann (1969), who believed female age to be one of the causes of this variation.

The cultivation of dragon fruit for commercial purposes in areas where *C. cactorum* occurs together with a reduced population of native host cacti may have induced these lepidopterans to adapt and start feeding on *Hylocereus* species. Thus, our report on the occurrence of *C. cactorum* on dragon fruit plants qualifies *C. cactorum* to be considered a potential pest, especially when dragon fruit is grown within the geographical distribution range of the moth.

## Acknowledgements

We thank the dragon fruit growers for allowing the survey to be conducted in their cultivation areas and Edilene Sacoman Longo Barros for collection of specimens and maintenance in the laboratory. We thank Dr. Vitor Osmar Becker for the identification of the specimens of *Cactoblastis cactorum*. We thank the anonymous reviewers and the academic editor for improving the manuscript.

## References

AUSTRALIAN GOVERNMENT DEPARTMENT OF AGRICULTURE AND WATER RESOURCES – DAWR, 2017 [viewed 8 February 2020]. *Final report for the review of biosecurity import requirements for fresh dragon fruit from Vietnam* [online]. Canberra: DAWR. Available from: https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/biosecurity/risk-analysis/plant-reviews/final-report-review-biosecurity-import-requirements-fresh-dragon-fruit-vietnam.pdf

BRAVO-AVILEZ, D., ZAVALA-HURTADO, J.A. and RENDÓN-AGUILAR, B., 2019. Damage in Cactaceae, their geographic distribution and new evidences. *Botanical Sciences*, vol. 97, no. 4, pp. 551-567. http://dx.doi.org/10.17129/botsci.2299.

BRIANO, J., VARONE, L., LOGARZO, G. and VILLAMIL, C., 2012. Extended geographical distribution and host range of the cactus moth, *Cactoblastis cactorum* (Lepidoptera: Pyralidae), in Argentina. *The Florida Entomologist*, vol. 95, no. 1, pp. 233-237. http://dx.doi.org/10.1653/024.095.0142.

CARRILLO, D., DUNCAN, R. and PEÑA, J.E., 2019 [viewed 6 December 2019]. *Pitaya (dragon fruit) (Hylocereus undatus) pests and beneficial insects* [online]. Florida: Tropical Research and Education Center. Available from: https://trec.ifas.ufl.edu/media/trecifasufledu/public-notices/Pitaya-EDIS.pdf

CHOI, K.S., YANG, J.Y., PARK, Y.M., KIM, S., CHOI, H., LYU, D. and KIM, D.S., 2013. Pest lists and their damages on mango, dragon fruit and atemoya in Jeju, Korea. *Korean Journal of Applied Entomology*, vol. 52, no. 1, pp. 45-51. http://dx.doi.org/10.5656/KSAE.2012.10.0.065.

DELGADO, A., KONDO, T., LÓPEZ, K.I., QUINTERO, E.M., MANRIQUE, M.B. and MEDINA, J.A., 2010. Biología y algunos datos morfológicos de la mosca del botón floral de la pitaya amarilla, *Dasiops saltans* (Townsend) (Diptera: Lonchaeidae) en el Valle del Cauca, Colombia. *Boletin del Museo de Entomologia de la Universidad del Valle*, vol. 11, no. 2, pp. 1-10.

DREW, R.A. and HANCOCK, D.L., 1994. The *Bactrocera dorsalis* complex of fruit flies (Diptera: Tephritidae: Dacinae) in Asia. *Bulletin of Entomological Research Supplement Series*, vol. 2, pp. 1-68. http://dx.doi.org/10.1017/S1367426900000278.

GALETTE, A.S., 2015. *Host range expansion of the Argentine cactus moth, Cactoblastis cactorum, onto dragon fruit, Hylocereus spp.* Florida: Florida Agricultural and Mechanical University, 80 p. Thesis or the degree of Masters of Science in Agricultural Sciences.

HIGHT, S.D., CARPENTER, J.E., BLOEM, K.A., BLOEM, S., PEMBERTON, R.W. and STILING, P., 2002. Expanding geographical range of *Cactoblastis cactorum* (Lepidoptera: Pyralidae) in North America. *The Florida Entomologist*, vol. 85, no. 3, pp. 527-529. http://dx.doi.org/10.1653/0015-4040(2002)085[0527:EGROCC]2.0.CO;2.

HOA, T.T., CLARK, C.J., WADDELL, B.C. and WOOLF, A.B., 2006. Postharvest quality of dragon fruit (*Hylocereus undatus*) following disinfesting hot air treatments. *Postharvest Biology and Technology*, vol. 41, no. 1, pp. 62-69. http://dx.doi.org/10.1016/j.postharvbio.2006.02.010.

JAYA, I.K.D., 2018 [viewed 3 March 2020]. Morphology and physiology of pitaya and its future prospects in Indonesia. *CROP AGRO, Jurnal Ilmiah Budidaya* [online], vol. 3, no. 1, pp. 44-50. Available from: https://cropagro.unram.ac.id/index.php/caj/article/view/60

LE BELLEC, F., VAILLANT, F. and IMBERT, E., 2006. Pitahaya (*Hylocereus* spp.): a new fruit crop, a market with a future. *Fruits*, vol. 6, no. 4, pp. 237-250. http://dx.doi.org/10.1051/fruits:2006021.

MANN, J., 1969. *Cactus-feeding insects and mites*. Washington: Smithsonian Institution Press. 158 p. United States National Museum Bulletin, no. 256. http://dx.doi.org/10.5479/si.03629236.256.1.

MARQUES, V.B., DE ARAÚJO, N.A., MOREIRA, R.A., RAMOS, J.D. and RIZENTAL, M.S., 2012. Ocorrência de insetos na pitaia no município de Lavras-MG. *Agrarian (Dourados)*, vol. 5, no. 15, pp. 88-92. http://dx.doi.org/10.30612/agrarian.v5i15.1116.

MCFADYEN, R.E., 1985. Larval characteristics of *Cactoblastis* spp. (Lepidoptera: Pyralidae) and the selection of species for biological control of prickly pears (*Opuntia* spp.). *Bulletin of Entomological Research*, vol. 75, no. 1, pp. 159-168. http://dx.doi.org/10.1017/S0007485300014231.

MIZRAHI, Y. and NERD, A., 1999. Climbing and columnar cacti–new arid lands fruit crops. In: J. JANICK, ed. *Perspective in new crops and new crops uses*. Alexandria: ASHS Press, pp. 358-366.

NERD, A., TEL-ZUR, N. and MIZRAHI, Y. 2002. Fruits of vine and columnar cacti. In: P.S. NOBEL, ed. *Cacti: biology and uses*. Berkeley: University of California Press, pp. 185-198.

NOBEL, P.S. and DE LA BARRERA, E., 2002. Stem water relations and wet $CO_2$ uptake for a hemiepiphytic cactus during short term drought. *Environmental and Experimental Botany*, vol. 48, no. 2, pp. 129-137. http://dx.doi.org/10.1016/S0098-8472(02)00016-3.

ORTIZ-HERNÁNDEZ, Y.D. and CARRILLO-SALAZAR, J.A., 2012. Pitahaya (*Hylocereus* spp.): a short review. *Comunicata Scientiae*, vol. 3, no. 4, pp. 220-237. http://dx.doi.org/10.14295/cs.v3i4.334.

PROGRAMA BRASILEIRO DE MODERNIZAÇÃO DO MERCADO HORTIGRANJEIRO – PROHORT, 2019 [viewed 3 March 2020]. *Programa Brasileiro de Modernização do Mercado de Hortigranjeiro: dados 2018/2019* [online]. Brasília: Ministério da Agricultura. Available from: http://dw.ceasa.gov.br/

RAMÍREZ-DELGADILLO, J.J., RODRÍGUEZ-LEYVA, E., LIVERA-MUÑOZ, M., PEDROZA-SANDOVAL, A., BAUTISTA-MARTÍNEZ, N. and NAVA-DÍAZ, C., 2011. Primer informe de *Cactophagus spinolae* (Gyllenhal) (Coleoptera: Curculionidae) em três especies de *Hylocereus* (Cactaceae) em Morelos, México. *Acta Zoológica Mexicana*, vol. 27, no. 3, pp. 863-866. http://dx.doi.org/10.21829/azm.2011.273789.

STILING, P., 2002. Potential non-target effects of a biological control agent, prickly pear moth, *Cactoblastis cactorum* (Berg) (Lepidoptera: Pyralidae), in North America, and possible management actions. *Biological Invasions*, vol. 4, no. 3, pp. 273-281. http://dx.doi.org/10.1023/A:1020988922746.

UNITED STATES DEPARTMENT OF AGRICULTURE – USDA. ANIMAL AND PLANT HEALTH INSPECTION SERVICE – APHIS, 2011 [viewed 5 February 2020]. *Pest list for the importation of dragon fruit (multiple genera and species) into the continental United States from Thailand* [online]. Raleigh: USDA. Available from: https://www.doc-developpement-durable.org/file/Arbres-Fruitiers/FICHES_ARBRES/pitaya/maladies/Pest%20List%20for%20the%20Importation%20of%20Dragon%20Fruit%20into%20the%20Continental%20United%20States%20from%20Thailand.pdf

ZIMMERMANN, H., BLOEM S. and KLEIN, H., 2004. *Biology, history, threat, surveillance and control of the cactus moth, Cactoblastis cactorum*. Vienna: IAEA. 40 p. FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture.

ZIMMERMANN, H.G., MORAN, V.C. and HOFFMANN, J.H., 2001. The renowned cactus moth, *Cactoblastis cactorum* (Lepidoptera: Pyralidae): its natural history and threat to native *Opuntia* floras in Mexico and the United States of America. *The Florida Entomologist*, vol. 84, no. 4, pp. 543-551. http://dx.doi.org/10.2307/3496386.