

Research Article

First records of the invasive species *Leptoglossus occidentalis* Heidemann (Hemiptera: Coreidae) on different coniferous species including the cedars of Lebanon

Primeras citas de la especie invasora *Leptoglossus occidentalis* Heidemann (Hemiptera: Coreidae) en diferentes especies de coníferas incluyendo los cedros del Líbano

Nabil Nemer^{1*}, Yara El Khoury², Elise Noujeim³, Yara Zgheib¹, Eustachio Tarasco² and Torsten van der Heyden⁴

¹Department of Agriculture and Food Engineering, Holy Spirit University of Kaslik, P.O. Box 446, Jounieh, Lebanon. *E-mail: nabilnemer@usek.edu.lb

²Department of Soil Plants and Food Sciences, University of Bari Aldo Moro, Via Amendola 165/A, I-70126 Bari, Italy.

³National Center for Marine Sciences, National Council for Scientific Research - CNRS, P.O. Box 11-8281, Ryad El Solh 1107 2260, 59, Zahia Selman street, Beirut, Lebanon.

⁴Immenweide 83, D-22523 Hamburg, Germany.

ZooBank: urn:lsid:zoobank.org:pub: DD0F3806-90B6-41E0-BB61-C438282C3951
<https://doi.org/10.35249/rce.45.4.19.01>

Abstract. The western conifer seed bug, *Leptoglossus occidentalis*, is an alien invasive species of North American origin. *Leptoglossus occidentalis* was recorded for the first time in Arsoun-Metn, Lebanon in 2015. Adults and nymphs of *L. occidentalis* were collected by the authors from various locations in Lebanon and observed on two species of pine, *Pinus pinea* and *Pinus brutia*, on *Juniperus excelsa* and even on *Cedrus libani*. This could indicate its successful integration in the country and its presence on many coniferous tree species. Studies to investigate the behaviour and the economic impact of this alien insect species in Lebanon are recommended.

Key words: *Cedrus libani*, distribution, Heteroptera, western conifer seed bug.

Resumen. La chinche de las coníferas occidental, *Leptoglossus occidentalis*, es una especie exótica invasora de origen norteamericano. *Leptoglossus occidentalis* se registró por primera vez en Arsoun-Metn, Líbano en 2015. Los autores recolectaron adultos y ninfas de *L. occidentalis* en varios lugares de este país y los observaron en dos especies de pino, *Pinus pinea* y *Pinus brutia*, en *Juniperus excelsa* e incluso en *Cedrus libani*. Esto podría indicar su establecimiento y naturalización en el país y su presencia en diversas especies de coníferas. Se recomiendan estudios para investigar el comportamiento y el impacto económico de esta especie invasora en el Líbano.

Palabras clave: *Cedrus libani*, chinche de las coníferas occidental, distribución, Heteroptera.

Introduction

The adult of *Leptoglossus occidentalis* Heidemann, 1910 is a large, reddish brown bug measuring 15 to 20 mm, having white zigzag band across the middle of the hemelytra, deltoid pronotum and lanceolate foliaceous metatibial dilations (Fent and Kment 2011).

Received 10 September 2019 / Accepted 30 September 2019 / Published online 16 October 2019
Responsible Editor: José Mondaca E.

The bug attacks conifers and during winter hides in holes of barks, in litter, or inside houses, even causing damage to plumbing materials and biting humans (Fent and Kment 2011; Ingels and Haviland 2014; Faúndez *et al.* 2019). About 40 species of conifers (family Pinaceae) can be hosts to the western conifer seed bug, mainly in the genera of *Pinus*, *Pseudotsuga*, *Abies*, and *Picea* (McPherson *et al.* 1990; Barta 2009; Fent and Kment 2011).

Leptoglossus occidentalis is native to the western areas of North America and started to spread out of the country after World War II. In 1992, it was reported in Pennsylvania after a period of silence and its range started to extend around the world (van der Heyden 2019a). The western conifer seed bug reached Europe in 1999 by invading Italy and was reported later from Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, France, Georgia, Germany, Greece, Hungary, Ireland, the Isle of Man, Kosovo, Liechtenstein, Luxembourg, Malta, Moldova, Monaco, Montenegro, the Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom as well as Morocco and Tunisia in Africa, China, Japan, Kazakhstan and South Korea in Asia, Costa Rica in Central America and Argentina and Chile in South America (van der Heyden 2017, 2018b, 2018c, 2019a, 2019b, 2019d; Kun and Masciocchi 2019). It was found near Lebanon in 2016 in eastern Turkey (Özgen *et al.* 2017) and has been recently reported in the northern part of the Golan Heights (van der Heyden 2018a) and in the western Galilee (van der Heyden 2019c). In February 2015, the presence of this new alien invasive insect in Lebanese stone pine woods in Arsoun in Mount Lebanon was confirmed (Nemer 2015).

Leptoglossus occidentalis feeds on seeds of conifers and can cause severe damages especially in pine stands. Starting 1999, a sudden decrease in pine nut production was observed in Italy and later on in many other *Pinus pinea* L. nuts producing countries (Bates *et al.* 2002). Affected cones were associated with remnants of saliva, puncture holes on the seed's pericarps and the presence of *L. occidentalis* on the trees (Strong *et al.* 2001). In fact, *L. occidentalis* bugs, both adults and nymphs, have long sucking piercing mouthparts they use to suck out the seed endosperm causing depletion and infertility of the seeds (Klass 2009; Ingels and Haviland 2014) leading to nut yield decrease (Nemer 2015). In Italy, serious losses in commercial pine nut production were recorded after *L. occidentalis* introduction in 1999 (Roversi 2009). Dried seeds and cones induce conelets abortion and loss of nut production. In several US states, Bates *et al.* (2000a, 2000b, 2002) reported the effect of *L. occidentalis* on abortion of cones of Douglas fir trees, *Pseudotsuga menziesii* (Mirb.) Franco, as well as its direct damage by depletion of the lipid and protein content of the seed up to its complete emptying. Also, their mouthparts carry fungal yeast, *Eremothecium coryli* Kurtzman, which cause discolouration of seeds (Ingels and Haviland 2014). Equally, Luchi *et al.* (2012) verified the ability of *L. occidentalis* of vectoring *Diplodia pinea* (Desm.) J.J. Kickx conidia, an endophytic fungus that colonize green tissues. The western conifer seed bug could spread the pathogen to new host plants. In addition, it can directly infect new cones and shoots (Tamburini *et al.* 2012).

Following the first record of *L. occidentalis* in Lebanon, this study aims to provide the distribution and occurrence of this insect and its host trees range in the country.

Materials and Methods

The study area expended over Lebanon from the south to the north where coniferous plantations exist. The distribution of *L. occidentalis* in Lebanon was studied all over the year from 2015 until 2018.

The insects were searched for on different coniferous plants, mainly Pinaceae family and to a lesser extent the Cupressaceae. Adults and nymphs were expected to be found around

the cones, thus trees bearing newly formed cones were exclusively chosen for insect's collection. Sweep netting and knocking on branches techniques including the Japanese umbrella were used to catch the insects. During overwintering when the temperature decreases, adults were searched in old and dead trees, among litter, barks and shrubs. The insects we encountered over the years were morphologically identified according to Fent and Kment (2011). All insects caught were deposited at the entomological collection of the entomology laboratory at the Faculty of Agricultural and Food Sciences of the Holy Spirit University of Kaslik.

Results

The presence of *L. occidentalis* in Lebanon was confirmed shortly after its first detection in 2015. However, starting 2012 a major threat was encountered in stone pine stands, referred to as the dry cone syndrome associated with empty pine seed. For this reason, invasive western conifer seed bug could have been introduced and established for years before its first detection. Considering the rapid spreading of the species, being recorded in Turkey in 2009 reinforces this hypothesis.

Adults and nymphs of *L. occidentalis* were found in 25 other localities (Figs. 1, 2): Bkassine, Qaitouli, Ras El Matn, Salima Baabda, Qsaybeh Baabda, Deir El Harf, Bzebdine, Qortada, Jouret Arsoun, Zandouka and Bhamdoun. Additionally, other specimens were collected from Ehden nature reserve, North Lebanon and Dlehta in Mount Lebanon, and lately one adult insect was found in the nature reserve of Tannourine (Fig. 1). Several findings of specimens indicate that *L. occidentalis* is now well implemented in the three main regions of pines forests in Lebanon, namely Bkassine (south Lebanon), Mount Lebanon and the North.

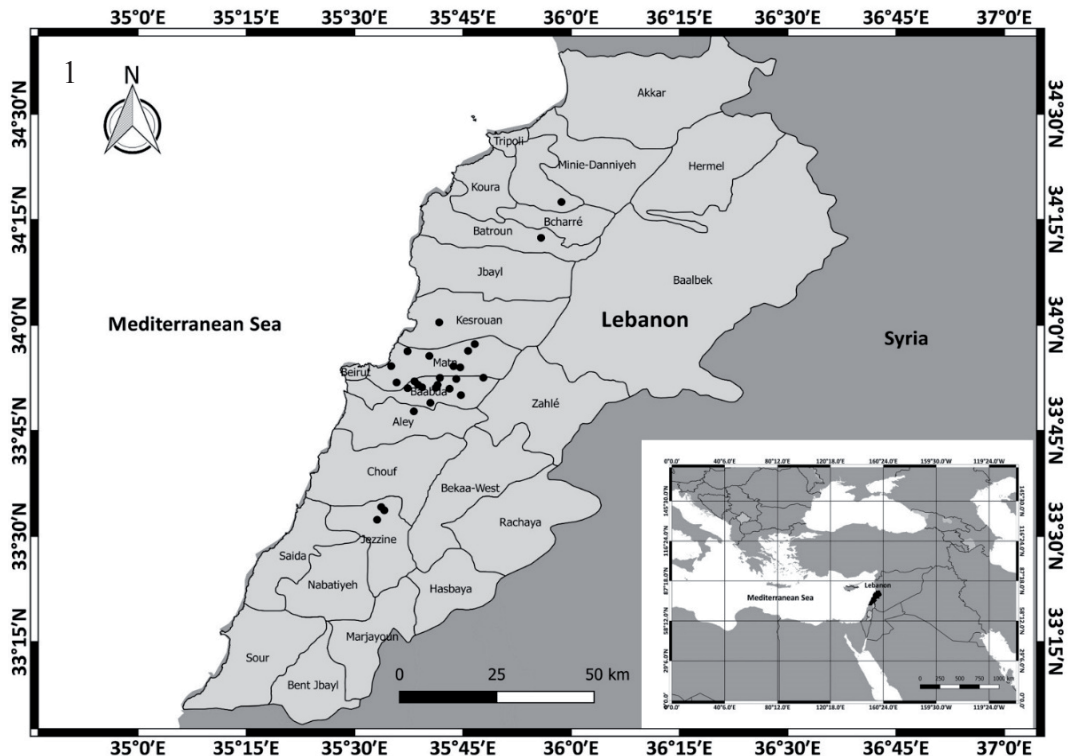


Figure 1. Distribution map of *Leptoglossus occidentalis* Heidemann in Lebanon.



Figure 2. Adult specimen of the western conifer seed bug, *Leptoglossus occidentalis* Heidemann, from Arsoun, Lebanon, caught in 2015 (Photograph: Staffan Kyrk). Scale: 5 mm.

Most specimens in Lebanon were collected from *P. pinea*, then *Pinus brutia* Ten., while in North of Lebanon individual adults as well as nymphal stages were captured in Ehden on *Juniperus excelsa* M. Bieb. (Cupressaceae) and on *Cedrus libani* A. Rich (Pinaceae). This insect has never been reported on the two latter tree species, therefore *C. libani* and *J. excelsa* are reported as new host plants of *L. occidentalis*.

Discussion

The species *P. pinea* is well established in Lebanon and is the second emblematic tree after *C. libani*. This invasive bug can affect natural regeneration of the first two emblematic trees in the country, in addition to the reduced pine nut yield and conelet losses that pine growers are suffering of during the past six years (Mutke *et al.* 2017). However, bug establishment is still limited to *P. pinea* stands as the highest insect population was found in stone pine stands. In Lebanon, stone pine extends over around 12,740 ha which represent 9.33% of the total forest cover in Lebanon (FAO 2005). Therefore, this insect pest has greater impact since it is affecting the yield production of pine nuts, one of the major economical commodities in non-wood forest products and which contribute to the living of at least 1000 families (Nemer 2015).

In North America, the native country of *L. occidentalis*, a single generation was observed per season (Jacobs 2002). Overwintering adults emerge from their shelters between mid-spring (1st of May) and early June to mate, feed and lay eggs (Fent and Kment 2011); they live until early August (FGC 2011). Females lay their barrel shaped eggs on needles between

mid-June and early August. Depending on weather conditions, eggs hatch in 10-15 days (Klass 2009; Jacobs 2002; Fent and Kment 2011) pass through five nymphal stages and become adults in 35-40 days (Fent and Kment 2011). However, the insect has an ability to adapt, population density and number of generations vary depending on rainfall, food availability, natural enemies and many other factors. Even though the bug is univoltine in North America, observations show the presence of three generations in Mexico (Mitchell 2000) and two generations in Sicily (Maltese *et al.* 2009). Also, Tamburini *et al.* (2012) estimated that *L. occidentalis* is multivoltine in Canada. In Lebanon, the warm weather may result in increase in the number of generations during the year, therefore higher damage level on pines. Adults were found in January, March, July, August, September, October and November in the surveys conducted. These records that extend along the aforementioned months imply the presence of two generations per year, confirmed by the presence of nymphal stages one and two in the same location in the months of May and June and then in August. The prevalence of a warm weather most of the year strengthens this hypothesis too.

According to its spatiotemporal distribution in Lebanon there may be a strong possibility that the western conifer seed bug has established a vital population and we should be alert of the economic and ecological consequences of this event on the cedars of Lebanon and the coniferous forests in general.

Acknowledgements

This work was funded partially through TCP/LEB/3501BABY funded by FAO. The authors would also like to acknowledge the National Council for Scientific Research of Lebanon (CNRS-L) for granting a doctoral fellowship to Yara El Khoury.

Literature Cited

- Barta, M. (2009)** New facts about distribution and host spectrum of the invasive Nearctic conifer pest, *Leptoglossus occidentalis* (Heteroptera: Coreidae) in south-western Slovakia. *Lesnícky časopis – Forestry Journal*, 55(2): 139-144.
- Bates, S.L., Borden, H., Kermode, A.R. and Bennett, R.G. (2000a)** Impact of *Leptoglossus occidentalis* (Hemiptera: Coreidae) on Douglas-Fir Seed Production. *Journal of Economic Entomology*, 93(5): 1444-1451.
- Bates, S.L., Borden, J.H., Savoie, A., Blatt, S.E., Lait, C.G., Kermode, A.R. and Bennett, R.G. (2000b)** Impact of Feeding by *Leptoglossus occidentalis* (Hemiptera: Coreidae) on the Major Storage Reserves of Mature Douglas-fir (Pinaceae) Seeds. *Canadian Entomologist*, 132: 91-102.
- Bates, S.L., Strong, W.B. and Borden, J.H. (2002)** Abortion and Seed Set in Lodgepole and Western White Pine Conelets Following Feeding by *Leptoglossus occidentalis* (Heteroptera: Coreidae). *Environmental Entomology*, 31(6): 1023-1029.
- FAO (Food and Agriculture Organization) (2005)** National Forest and Tree Assessment and Inventory. TCP/LEB/2903. FAO, Food and Agriculture Organization, Ministry of Agriculture. Baabda. 112 pp.
- Faúndez, E.I., Carvajal, M.A. and Villablanca, J. (2019)** Alien Invasion: The Case of the Western Conifer-Seed Bug (Heteroptera: Coreidae) in Chile, Overreaction, and Misidentifications. *Journal of Medical Entomology*, tjz127: 1-7.
<https://doi.org/10.1093/jme/tjz127>. (Accessed: 27-IX-2019)
- Fent, M. and Kment, P. (2011)** First record of the invasive western conifer seed bug *Leptoglossus occidentalis* (Heteroptera: Coreidae) in Turkey. *North-Western Journal of Zoology*, 7(1): 72-80.

- FGC (Forest Genetics Council of British Columbia) (2011)** Cone and Seed Insect Pest, Leaflet No. 4. Western Conifer Seed Bug (*Leptoglossus occidentalis*). British Columbia Ministry of Forests and Range, Tree Improvement Branch. Saanichton. Retrieved from <http://www.fgcouncil.bc.ca/PM-Factsheet04-Leptoglossus-occidentalis.pdf>. (Accessed: 24-III-2019)
- Ingels, C. and Haviland, D. (2014)** Leaf-footed Bug (Pest Notes Publication 74168). University of California, Statewide Integrated Pest Management Program. Davis.
- Jacobs, S. (2002)** Western conifer seed bug *Leptoglossus occidentalis*. Retrieved from http://www.ento.psu.edu/extension/factsheets/western_coniferseed_bug.htm. (Accessed: 24-III-2019).
- Klass, C. (2009)** Western Conifer Seed Bug: An Unwanted House Guest. Retrieved from <https://www.maine.gov/dacf/php/gotpests/bugs/factsheets/wcsb-cornell.pdf>. (Accessed: 24-III-2019).
- Kun, M.E. and Masciocchi, M. (2019)** First detection of the cosmopolitan invader *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae) in Argentina. *Anais da Academia Brasileira de Ciências*, 91(3): e20180493. <http://dx.doi.org/10.1590/0001-3765201920180493>. (Accessed: 27-IX-2019).
- Luchi, N., Mancini, V., Feducci, M., Santini, A. and Capretti, P. (2012)** *Leptoglossus occidentalis* and *Diplodia pinea*: a new insect-fungus association in Mediterranean forests. *Forest Pathology*, 42(3): 246-251.
- Maltese, M., Caleca, V. and Carapezza, A. (2009)** Primi reperti in Sicilia su diffusione e biologia di *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae), cimice americana dei semi delle conifer. In: Atti del Terzo Congresso Nazionale di Selvicoltura: 1413-1418. Taormina (ME), 16-19 ottobre 2008. *Accademia Italiana di Scienze Forestali*. Florence.
- McPherson, J.E., Packauskas, R.J., Taylor, S.J. and O'Brien, M.F. (1990)** Eastern range extension of *Leptoglossus occidentalis* with a key to *Leptoglossus* species of America north of Mexico (Heteroptera: Coreidae). *Great Lake Entomologist*, 23(2): 99-104.
- Mitchell, P.L. (2000)** Leaf-footed bugs (Coreidae). In: Schaeffer, C.W. and Panizzi, A.R. (eds.). *Heteroptera of Economic Importance*: 337-403. CRC Press. Boca Raton.
- Mjøs, A.T., Nielsen, T.R. and Ødegaard, F. (2010)** The Western Conifer Seed Bug (*Leptoglossus occidentalis* Heidemann, 1910) (Hemiptera, Coreidae) found in SW Norway. *Norwegian Journal of Entomology*, 57: 20-22.
- Mutke, S., Calama, R., Nasrallah Neaymeh, E. and Roques, A. (2017)** Impact of the Dry Cone Syndrome on commercial kernel yield of stone pine cones. *Options Méditerranéennes, Series A: Mediterranean Seminars*, 122: 79-84.
- Nemer, N. (2015)** Report on insect pests associated with conelet losses and their management in *Pinus pinea* forests in Lebanon. TCP/LEB/3501BABY. FAO. Baabda. 45 pp.
- Özgen, İ., Dioli, P. and Çelik, V. (2017)** New and interesting record of western conifer seed bug: *Leptoglossus occidentalis* (Heidemann, 1910) (Heteroptera: Coreidae) in Eastern Turkey. *Journal of Entomology and Zoology Studies*, 5(5): 830-833.
- Roversi, P.F. (2009)** Adattamento di specie neo-introdotte, *Leptoglossus occidentalis* Heidemann. In: Jucker, C., Barbagallao, S., Roversi, P.F. and Colombo, M. (eds.). *Insetti Esotici e Tutela Ambientale*: 224-229. Arti Grafiche Maspero Fontana & C. Cermenate.
- Strong, W.B., Bates, S.L. and Stoehr, M.U. (2001)** Feeding by *Leptoglossus occidentalis* (Hemiptera: Coreidae) reduces seed set in lodgepole pine (Pinaceae). *The Canadian Entomologist*, 133(6): 857-865.
- Tamburini, M., Maresi, G., Salvadori, C., Battisti, A., Zotte, F. and Pedrazzoli, F. (2012)** Adaptation of the invasive western conifer seed bug *Leptoglossus occidentalis* to Trentino, an alpine region (Italy). *Bulletin of Insectology*, 65(2): 161-170.

- van der Heyden, T. (2017)** *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Heteroptera: Coreidae: Coreinae: Anisoscelini) has reached the Greek island of Crete. *Archivos Entomológicos*, 18: 185-187.
- van der Heyden, T. (2018a)** First record of *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Heteroptera: Coreidae: Coreinae: Anisoscelini) in the Golan Heights. *Revista gaditana de Entomología*, 9: 1-3.
- van der Heyden, T. (2018b)** First record of *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae: Coreinae: Anisoscelini) in Albania. *Revista Chilena de Entomología*, 44(3): 355-357.
- van der Heyden, T. (2018c)** New data on the distribution of *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae: Coreinae: Anisoscelini), including the first record of the species in Georgia. *Revista Chilena de Entomología*, 44(4): 433-435.
- van der Heyden, T. (2019a)** First record of *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae: Coreinae: Anisoscelini) in Costa Rica. *Revista Chilena de Entomología*, 45(1): 51-53.
- van der Heyden, T. (2019b)** New data on the biology and distribution of *Leptoglossus occidentalis* Heidemann, 1910 (Hemiptera: Heteroptera: Coreidae: Coreinae: Anisoscelini). *Archivos Entomológicos*, 21: 31-32.
- van der Heyden, T. (2019c)** *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae: Coreinae: Anisoscelini) in Israel. *Revista Chilena de Entomología*, 45(3): 435-437.
- van der Heyden, T. (2019d)** Summarized data on the European distribution of *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae: Coreinae: Anisoscelini). *Revista Chilena de Entomología*, 45(3): 499-502.