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Scientific Note

The invasive plant *Pittosporum undulatum* Ventenat (Pittosporaceae) hosting pest-stink bugs in Southern Brazil

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Abstract. A survey of stink bugs (Hemiptera: Heteroptera: Pentatomidae) was conducted on the invasive tree, *Pittosporum undulatum* Ventenat (Pittosporaceae) in southern Brazil (Passo Fundo – RS, latitude 28°15′46″ S; longitude 52°24′24″ W) aiming to know if this exotic plant might host these insects. Results indicated that *P. undulatum* was found hosting the stink bugs *Chinavia erythrocnemis* (Berg, 1878), *Chinavia impicticornis* (Stål, 1872) and *Loxa deducta* Walker, 1867. *Chinavia impicticornis* was rare (only one nymph collected) while *C. erythrocnemis* was much more abundant (30 adults collected), and nymphs were able to develop and adult to reproduce on fruits of *P. undulatum* in the laboratory; however, the viability of nymphs was negatively affected. *Loxa deducta* was intermediate (20 adults collected) and, from the only egg mass obtained in the laboratory, nymphs died few days later. The results suggest that *P. undulatum* may provide some nutrients and shelter, but not provide ideal conditions to guarantee the continuous development of these stink bugs species.

Keywords*:* Pentatomidae, Pittosporaceae, host plant, biology.

Pittosporum undulatum Ventenat (Pittosporaceae), originary from Australia, is known as an invasive tree in many countries of Asia, Africa, the Americas, Europe and Oceania (CABI 2019). In Brazil, this species has been reported to occur in the Southeast (Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo states) and in the South (Paraná, Rio Grande do Sul, and Santa Catarina states) regions (Pirani 2015). This tree has been used in urban landscape areas as an ornamental plant (Lorenzi et al. 2003).

In Brazilian conditions, *P. undulatum* grows to 5-6 m high (Fig. 1A). It usually spread mature seeds under the canopy originating seedlings (Fig. 1B). It has typical leaves with wavy (undulating) leaf edges. It carries conspicuous orange woody fruits about 1 cm in diameter, containing shiny reddish-brown seeds, ca. 20 per fruit (Oliveira & Paoli 2009). Fruit/seeds contain essential oils (monoterpenes and sesquiterpenes) known to have detrimental effects on eggs and larvae of the caterpillar *Pseudaletia unipuncta* (Haworth, 1809) (Lepidoptera: Noctuidae) (Rosa et al. 2010). Leaves also have toxic compounds (Lago et al. 2006) shown to kill the termite *Heterotermes sulcatus* Mathews, 1977 (Blattodea: Rhinotermitidae) (Almeida et al. 2015).

Despite the presence of toxic compounds in fruits/leaves, several species of phytophagous insects have been recorded to feed on *P. undulatum*, such as the sucking scales and mealybugs *Parlatoria pittospori* Maskell, 1891 (Hemiptera: Diaspididae) (Timlin 1964), *Ceroplastes floridensis* Comstock, 1881 (Hemiptera: Coccidae), *Aspidiotus nerii* Bouché, 1833 (Hemiptera: Diaspididae), and *Pseudococcus longispinus* (Targioni Tozzetti, 1867) (Hemiptera: (Pseudococcidae) (Ben-Dov 2011-2012), and the aphids *Macrosiphum tonantzin* Peña-Martínez, Muñoz-Viveros & Jensen, 2019 (Hemiptera: Aphididae) (Jensen et al. 2019), and *Aphis craccivora* Koch, 1854 (Hemiptera: Aphididae) (Mokhtari et al. 2012). Among the true bugs (Heteroptera), one species of mirid *Monalonion velezangeli* Carvalho and Costa, 1988 (Hemiptera: Miridae) is recorded (Ocampo Flórez et al. 2018). So far, one species of Pentatomidae have been recorded in Australia, *Monteithiella humeralis* (Walker, 1868) on *P. undulatum* (North Dakota State University 2020). The only species of Pentatomidae registered in the neotropics on *P. undulatum* is *Piezodorus guildinii* (Westwood, 1837) in Uruguay (Zerbino et al. 2015).

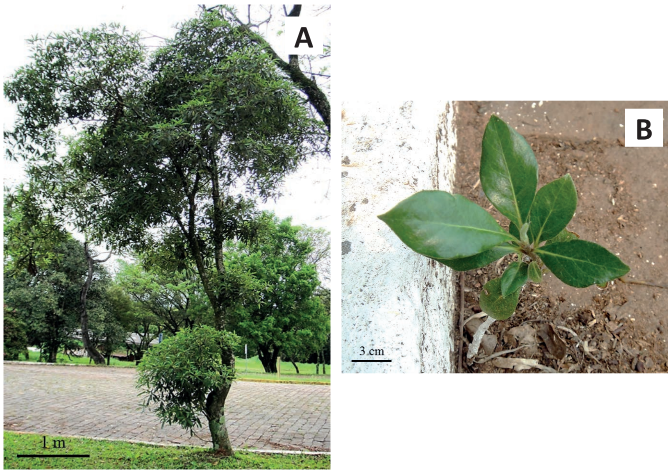

Figure 1. A - *Pittosporum undulatum* adult plant where the stink bugs were collected and B - seedling underneath the plant canopy.

As *P. undulatum* is known eventually to host stink bugs as previously indicated, and considering the lack of information on the occurrence of stink bugs on *P. undulatum* in southern Brazil, we surveyed trees and species collected were taken to the laboratory to study the nymph and adult biology on fruits of this plant. We believe that this study is relevant to evaluate the importance of this potential host tree to increase populations of pest species stink bugs. However, one should take into consideration that the plant, as being exotic, has a somewhat limited distribution, which might mitigate its impact on the stink bugs found colonizing it. Moreover, its utilization is probably due to the absence of preferred host plants (e.g., leguminous plants) during some times of the year.

During March 2018, weekly surveys were carried out on *P. undulatum* trees located in the urban area and nearby distributed in Passo Fundo, RS, Brazil (latitude 28°15'46" S; longitude 52°24´24" W). Stink bugs were collected using a sweep net, scanning the lower branches of five trees. They were taken to the Laboratory of Entomology of Embrapa Trigo and placed on separated clear plastic rearing boxes (24 x 17 x 20 cm) inside a walk-in environmental chamber (25 ± 1°C, 60 ± 10% RH, photophase 14h of light). Nymphs of each pentatomid species were separated and placed in the plastic boxes as above to obtain adults. They were fed with fruits *ad libitum* of *P. undulatum*, changed every two days; this was done because pentatomids usually feed on fruits/seeds. A moisturized cotton wad was provided as a source of water. Adults obtained were used to establish laboratory colonies and some were pinned for later identification.

From the adults and nymphs (reared to adults in the laboratory) collected on *P. undulatum* trees, three species of stink bugs were obtained: *Chinavia erythrocnemis* (Berg, 1878), *Chinavia impicticornis* (Stål, 1872) and *Loxa deducta* Walker, 1867.

Ten adult couples, originated from nymphs field-collected, of the two more common species (*C. erythrocnemis* and *L. deducta*) were placed in plastic boxes, fed with *P. undulatum* fruits, and toilet paper plus cotton wad were provided as egg laying substrates. Egg masses obtained were removed and placed inside clear plastic boxes (11 x 11 x 3.5 cm). As nymphs emerged, they were placed in the bigger rearing boxes, fed with fruits of *P. undulatum*. Every other day, the boxes were checked and the number of surviving nymphs were recorded up to the day they all reached the adult stage or died. From these records, the following parameters were calculated: number of egg/mass; mean time (days) for egg hatch; viability (%) from egg to 1st instar; developmental time (days) 1st instar to adult; viability (%) 1st instar nymph to adult; developmental time (days) egg to adult; and viability (%) egg to adult.

Chinavia erythrocnemis is polyphagous and reported on plants of several families (e.g., Schwertner & Grazia 2007; Matesco et al. 2006; Marsaro Júnior et al. 2017). In the family Pittosporaceae and on the species *P. undulatum*, this is the first record. *Chinavia erythrocnemis* was the most abundant species collected (20 nymphs and 30 adults). In the laboratory, it was the stink bug species with the better performance fed on fruits of *P. undulatum* (Tab. 1). From the initial 25 egg masses (Fig. 2A) obtained in the laboratory, eggs took ca. 6 days to hatch and ca. 87% nymphs successfully emerged from eggs. Nymph developmental time was relatively long, taking ca. 67 days to reach the adult stage (Tab. 1; Fig. 2E). About 50% of nymphs (Figs. 2B-D) were able to complete development from the day eggs hatched. However, from 12 egg masses obtained from adults reared in the laboratory, no nymphs survived and all died few days after emergency.

Table 1. Biological parameters of *Chinavia erythrocnemis* and *Loxa deducta* feeding on fruits of *Pittosporum undulatum* obtained in the laboratory from laboratory reared nymphs and adults.

Parameters	Species	
	***C. erythrocnemis* (n) (mean ± SE)**	***L. deducta*[1]**
Number of eggs/mass	12.0 ± 0.2 (25)[2]	13.0
Time (days) for egg hatch	5.8 ± 0.2 (169)[3]	6.0
Viability (%) from egg to 1st instar	87.1 ± 3.7 (195)[3]	69.2
Developmental time (days) 1st instar to adult	67.5 ± 2.0 (25)[3]	-
Viability (%) 1st instar nymph to adult	57.6 ± 11.1 (44)[3]	-
Developmental time (days) egg to adult	73.1 ± 2.1 (25)[3]	-
Viability (%) egg to adult	48.1 ± 11.8 (52)[3]	-

[1]Only one egg mass obtained; all nymphs died few days after emergency; [2]number of egg mass; [3]number of egg/nymphs obtained in the laboratory

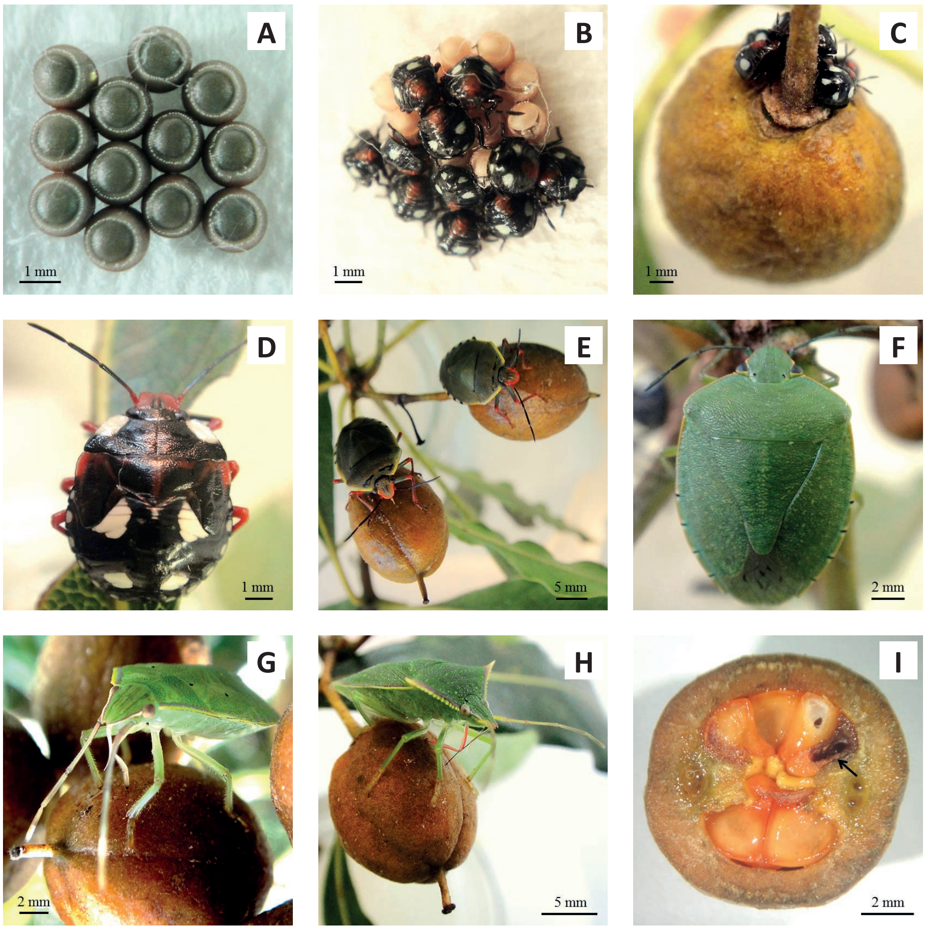

Figure 2. Stink bugs associated with *Pittosporum undulatum* in Passo Fundo, RS, Brazil. *Chinavia erythrocnemis*: A - egg mass, B - 1st instar nymphs on top of egg shells, C - early nymphs on fruit, D - late instar nymph, E - adults on fruits. *Chinavia impicticornis*: F - adult. *Loxa deducta*: G - 5th instar feeding on fruit, H - adult feeding on fruit. I - open fruit showing seed damaged by the feeding activity of stink bugs (indicated by arrow).

This fact indicates that fruits of *P. undulatum* might have antibiosis effects, preventing nymph to survive (see discussion ahead). In addition, the relatively long time of nymph development observed in this study, highly differ from what was reported for *C. erytrocnemis* - 31 to 43 days to complete development on cultivated plants, such as soybean, *Glycine max* (L.) Merrill, green bean, *Phaseolus vulgaris* L., canola, *Brassica napus* L. var. *oleifera*, and wheat, *Triticum aestivum* L. (Lucini et al. 2020), and from data on the similar species *Chinavia pengue* (Rolston, 1983) that took ca. 38 to 46 days on green beans (Matesco et al. 2007). These data reinforce the unsuitability of *P. undulatum* to *C. erythrocnemis.* Egg masses obtained, however, had ca. 12 eggs/mass, similar to what was observed on green bean for *C. erytrocnemis* (Matesco et al. 2006). These results suggest that *C. erythrocnemis* may use *P. undulatum* as an occasional source of nutrients at times when preferred hosts are unavailable.

The second species obtained *C. impicticornis* was observed only once, and the nymph collected originated a female (Fig. 2F). Considering being rare on *P. undulatum* we deduct that this is not a suitable host plant. Similar to the previous stink bug species, *C. impicticornis* is also polyphagous and reported on several plant families (Schwertner & Grazia 2007; Bianchi et al. 2019). Similarly, this is the first report of its occurrence on *P. undulatum*.

The third species, *L. deducta* was collected as nymphs (n = 25; Fig. 2G) and adults (n = 20; Fig. 2H). Laboratory rearing originated one egg mass (13 eggs), which after 6 days originated nymphs (ca. 70% hatched) (Tab. 1). However, all nymphs died. *Loxa deducta* is reported on plants of several families (e.g., Link & Grazia 1987; Panizzi & Grazia 2001). Its occurrence on *P. undulatum* is a new record.

Visual observations in the laboratory and in the field indicated that *C. erytrocnemis*, *C. impicticornis* and *L. deducta*, fed on fruits of *P. undulatum*, causing damage (Fig. 2I). They moved their stylets vigorously back and forth, similar to another stink bug, *Runibia perspicua* (F., 1798), which feed on seeds of capsule fruits of the ornamental plant *Brunfelsia australis* (Solanaceae) (Marsaro Júnior et al. 2018). This feeding strategy of cell dilacerations plus salivary enzymes (maceration) cause mechanical and chemical damage. These damages caused by stink bugs in seeds may help to prevent the spread of this invasive plant.

The poor performance of all species of stink bugs observed on *P. undulatum* might be due to the toxic compounds present in leaves and fruits as proved for other species of insects (Rosa et al. 2010; Almeida et al. 2015). Perhaps, future studies may reveal fully their detrimental effects on the stink bugs collected. Moreover, perhaps offering other plant structures in addition to fruits as food, could have yielded a better performance of the bugs.

Little information is available specifically on the role of ornamental plants hosting pest species of stink bugs. Usually, data of host or associated plants, including those cultivated or non-cultivated, seldom include ornamental plants (Smaniotto & Panizzi 2015).

In conclusion, our laboratory and field observations suggest that *P. undulatum* fits more as an associated plant than a host. Associated plants are those utilized by insects only eventually, and usually, they are not able to reproduce on them (see details in Panizzi & Lucini 2017). This plant may provide some nutrients and shelter, and do not provide conditions for the continuous development of generations of these species of stink bugs observed on the plant in Southern Brazil.

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Authors' contributions

ALMJ co-planed, co-executed, and co-wrote. ARP co-planed and co-wrote. ACS co-executed and TL co-wrote the manuscript.

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