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Hercinothrips dimidiatus Hood (Thysanoptera: Thripidae), a new pest of *Aloe arborescens* Miller in Europe

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Abstract *Hercinothrips dimidiatus* Hood (Thysanoptera: Thripidae) was detected in several localities in the region of Lisbon, in Portugal, infesting *Aloe arborescens* Miller (Asphodelaceae) and causing considerable damage. This is the first record of this thrips in Europe and in the Palaearctic region.

Key-words thrips · *Aloe* · invasive species · Portugal

The krantz aloe, *Aloe arborescens* Miller (Asphodelaceae), is a succulent plant which usually develops into a 2-3 m high multiheaded-shrub. The grey-green leaves are arranged in rosettes and bear conspicuous pale teeth on their margins (Hankey & Notten 2004; Smith *et al.* 2012). This species is one of the most widespread species in the genus. It is native to Southern Africa, being present from the Cape Peninsula up to the eastern mountains of Zimbabwe and Malawi (Hankey and Notten 2004; Smith *et al.* 2012; Sung 2006). *Aloe arborescens* has been cultivated in South Africa, Japan and Europe since the 17th century (Hankey & Notten 2004; Smith *et al.* 2012). Nowadays, it is widely cultivated in the tropics and subtropics, and is a very common garden plant in the Mediterranean. *Aloe arborescens* is commercially grown, mostly for medicinal and cosmetic uses in different countries, including Italy, Japan, Israel and China (Smith *et al.* 2012; Sung 2006). Several medicinal uses have been reported, including wound-healing, anti-bacterial, anti-ulcer, anti-inflammatory, anti-carcinogenic, alopoeic and anti-fungal activity (Smith *et al.* 2012). *Aloe* extracts were also reported as potential botanical pesticides owing to their insecticidal and fungicidal properties (e.g. Chore *et al.* 2014; Ko *et al.* 2009; Simmonds 2004). In Portugal, *A. arborescens* is common as ornamental plant. It has also been planted along the coastal area around Lisbon for beautifying the landscape and preventing soil erosion and has become naturalised. In certain areas, such as Nazaré, in the Atlantic coast of Portugal, *A. arborescens* is considered an invasive species (Smith & Figueiredo 2009).

Aloe plants are generally not attacked by herbivores (Cutler 2004). However, they may be damaged by a few groups of insects and mites, including mealybugs, soft scales, aphids, beetles, and eriophyids (Kelly and Olsen

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2008; Simmonds 2004). Thrips, such as *Frankliniella occidentalis* (Pergande), *Heliothrips haemorrhoidalis* (Bouché) and *Thrips tabaci* Lindeman (Thysanoptera: Thripidae), have also been reported on flowers of *Aloe,* but causing no apparent damage (Simmonds 2004). The genus *Hercinothrips* includes nine species which are considered native to Africa: *H. aethiopiae* Mound, *H. bicinctus* (Bagnall), *H. brunneus* Hood, *H. dimidiatus* Hood, *H. femoralis* (Reuter), *H. jansei* Faure, *H. pattersoni* (Bagnall), *H. tenuis* Hartwig, and *H. trilineatus* (Priesner) (Wilson 1975). Only two *Hercinothrips* species were known from Europe till now, namely *H. bicinctus* and *H. femoralis* (Vierbergen 2013).

In this note, we report the presence of *H. dimidiatus* in Portugal, infesting *Aloe arborescens*. This is the first record of this thrips species in Europe and in the Palearctic region.

A cluster of *A. arborescens* showing damaged leaves was first observed in January of 2012 in the gardens of the Laboratório Nacional de Engenharia Civil (LNEC), in Lisbon (*Mário Oliveira, personal communication*). The older leaves of the damaged plants were dark brown to almost black. Mature leaves showed silvering areas on the upper surface, associated with small discolored scarifications and covered with dark colored excrement droplets, indicating the presence of thrips. Some of those mature leaves had dark red areas associated with small black necroses. A general silver appearance was observed in the most necrotic clusters (Fig. 1a and b). Similar damages were then observed at several places around Lisbon. Recently, the thrips that were collected in association with the described leaf damage were identified as *H. dimidiatus.*

In order to investigate the distribution of this alien species, as well as the importance of the associated damage, a survey was carried out, from September 2014 to March 2015, in an area about 60 km north of Lisbon. *Aloe arborescens* plants were inspected/sampled at 15 places, including public and private gardens as well as naturalised plant clusters. At each sampled place, the plants were inspected for the presence of thrips, whenever they showed the typical leaf damage described above. The collected adult thrips, all females, were mounted on microscope slides (Fig. 1c) and identified by using Mound (1965) and Mound and Kibby (1998) keys. Prepared slides were deposited in the collection of Instituto Nacional de Investigação Agrária e Veterinária, in Oeiras. *Hercinothrips dimidiatus* was found in the following localities: Lisbon (two localities - LNEC gardens N: 38°45'30.96", W: 9°8'27.96" and Tapada da Ajuda N: 38°42'28.44", W: 9°11'11.76"), Oeiras (three localities - Quinta do Marquês N: 38°41'47.76", W: 9°19'8.4"; Nova Oeiras N: 38°41'34.08", W: 9°19'36.48" and S. Julião da Barra N: 38°40'35.04", W: 9°19'23.88"), Cascais (three localities - Boca do Inferno N: 38°41'40.2", W: 9°26'3.48"; Guia N: 38°41'45.6", W: 9°26'47.76" and Cascais town N: 38°42'0", W: 9°25'34.68") and Sintra (1 locality - Queluz N: 38°45'25.92", W: 9°15'36.72"). Other places showed symptoms but no thrips were detected, probably owing to the fact that most survey inspections occurred during the winter. No damaged leaves were observed on *A. arborescens* plants in the Torres Vedras region, namely at the localities Gibraltar (N: 39°5'27.24", W: 9°18'9") and Santa Cruz (N: 39°8'34.8", W: 9°22'15.6").

Hercinothrips dimidiatus was first described from specimens collected on a liliaceous plant, in South Africa (Hood 1937). In 1941, it was intercepted in California on *Haworthia altilinea* Haword (=*H. mucronata* Haword) (Asphodelaceae) imported from South Africa (USDA 1942). It is reasonable to believe that its introduction into Portugal occurred through importation of infested plants from South Africa, possibly *Aloe* sp. or *Haworthia* sp.

This is the first time this thrips species has been detected as established outside its native region. In Portugal the species is apparently restricted to an area along the north river bank of Tagus estuary, between Lisbon and Cascais, and along the Atlantic coast, in the Natural Park of Sintra-Cascais. This suggests that Lisbon, with an international maritime port and airport, was most probably the area of introduction of this alien species.

The genus *Hercinothrips* may be separated from related genera based on the following combination of characters: tarsi two segmented; first vein of forewing with almost complete row setae; venal setae stout, usually as long as median width of fore-wing; dorsal surface of head near posterior margin with weak transverse ridge, visible laterally as a small projection; head constricted posterior to ridge to form a basal collar; maxillary palpi two-segmented; antennal segments III and IV with forked sense cones (Mound 1965). *Hercinothrips dimidiatus* is recognized (in the case of adult females) by the median pale area of the fore-wing equal to or longer than the first dark cross band; head yellow (Fig. 1d); microtrichia present on antero-lateral part of abdominal tergites two to six (Fig. 1e; Mound 1965).

Fig. 1 *Hercinothrips dimidiatus* on *Aloe arborescens*: a) cluster of damaged plants; b) aspect of leaf damage; c) adult female of *H. dimidiatus*; d) and e) slide-mounted thrips showing wing, head and abdominal characteristics specific to *H. dimidiatus*; f) transverse section of a damaged leaf of *Aloe*: 1 – epidermis + chlorenchyma; 2 – mesophyll.

There is no information on the biology of *H. dimidiatus.* We observed that the yellow-brownish larvae feed and complete development on the upper surface of the mature leaves of *A. arborescens.* Prepupae and pupae were rarely detected on the leaves. Adults may be found also in the flowers. Damage is associated with thrips feeding. Apparently, the feeding discoloured spots in a later stage give rise to larger black necroses which are surrounded by dark reddish areas. These areas may expand up to all the surface of the leaf, including the lower surface. Frequently, leaves turn black in colour and die. In a transverse section, we observed that the damaged tissue is restricted to the surface of the epidermis and upper layers of chlorenchyma (Fig. 1f).

The characteristics and spatial pattern of the observed damage are possibly related to the particular leaf anatomy and physiology of *Aloe* plants. The leaves, in cross section, bear an external epidermis with a thick cuticle cover, followed by the rind tissue. This consists of several layers of chlorenchyma, containing the green chloroplasts, and the inner mesophyll of parenchymatous cells, which are assumed to store water and the leaf exudates, as well as other constituents involved in the plant defence. A ring of vascular bundles occurs just beneath the chlorenchyma cells (Coopoosamy & Naidoo 2011; Cutler 2004; Wintola & Afolayan 2014). When a leaf is damaged, the exudates are oozed out from the parenchymatous cells and released in the damaged area, becoming suberized and forming thereafter a scar (Coopoosamy & Naidoo 2011). This is possibly the process responsible for producing the black necroses and dark reddish areas we observed in association with thrips feeding spots on the leaves of *A. arborescens* (Fig. 1f).

Aloe arborescens contains three different secondary phenol metabolites in the leaves (barbaloin, aloeresin, and aloenin), which are part of the chemical defence system of the plant against herbivores. It was found that content of these secondary metabolites was highest in the younger leaves, as well as in the upper part of the leaves; it was higher in the leaf margins than in the leaf centre, and also highest along the margins of the upper third of the leaf and lowest at the centre of the leaf base (Gutterman and Chauser-Volfson 2007). It is interesting to note that the plant parts in which we observed higher levels of damage caused by *H. dimidiatus* seemed to be correlated with those where the content of secondary metabolites is expected to be lowest.

Studies on life history of *H. dimidiatus* and its possible interaction with plant pathogens, as well as on the development of effective control measures are being carried out.

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