DISTRIBUTION, FOOD PLANTS AND CONTROL OF *ASYMMETRASCA DECEDENS* (PAOLI, 1932) (HEMIPTERA: CICADELLIDAE)

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With 3 figures and 1 table

ABSTRACT. *Asymmetrasca decedens* is a polyphagous species and a pest of many cultivated plants. Although it is mainly distributed in the Mediterranean region, recently it has been reported also from Madeira Island. So far here it has been found mainly in southern coastal areas on a reduced number of plants; this suggests that the species might have been introduced recently. In Oceanic islands as Madeira free vacant niches and reduced competition are common features that can favour the establishment of invasive species. Thus, if this leafhopper were introduced recently, it would be expected to increase its food plant range and distribution subsequently. Although the flora of Madeira is different from that of the Mediterranean region, the potential risk of attacking new plants should be not underestimated. To become aware of which plants are more likely to be attacked in this new ecosystem, it is necessary to know the actual host plant range of this species. Because such data are greatly scattered, we compile here the published information on food plant associations, distribution and control. According to this information, *A. decedens* is widely distributed in the Palaearctic region and is associated with many cultivated plants. It has been recorded on sixty-one different plants species, of which 75% are present in Madeira.

KEY WORDS: Hemiptera, leafhoppers, *Asymmetrasca*, Madeira, distribution, food plants, control.

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RESUMO. *Asymmetrasca decedens* é uma espécie polífaga, praga em muitas plantas cultivadas. Embora encontre-se distribuída principalmente na região Mediterrânea, recentemente tem sido referenciada também para a Ilha da Madeira. Até à data tem sido encontrada principalmente nas áreas costeiras do Sul da Ilha sobre um número reduzido de plantas, o que sugere que esta espécie pode ter sido introduzida recentemente. Nas ilhas oceânicas como a Madeira a existência de nichos desocupados e uma reduzida competição são características comuns que podem favorecer o estabelecimento de espécies invasoras. Assim, se esta cigarrinha tivesse sido introduzida recentemente, esperar-se-ia que viesse a aumentar o número de plantas hospedeiras utilizadas e consequentemente a sua distribuição. Embora a flora da Madeira seja diferente da flora da região Mediterrânea, o risco de poder atacar novas espécies de plantas não deve ser subestimado. Para saber quais as plantas que têm maior probabilidade de serem atacadas neste novo ecossistema, é necessário conhecer o número actual de plantas hospedeiras desta espécie. Como estes dados estão amplamente dispersos, compilamos aqui os dados publicados sobre plantas hospedeiras, distribuição e controlo. Segundo esta informação *A. decedens* encontra-se amplamente distribuída na região Paleárctica e está associada a muitas plantas cultivadas. Foi encontrada em sessenta e uma espécies de plantas diferentes das quais 75% estão presentes na Madeira.

PALAVRAS-CHAVE: Hemiptera, cigarrinhas, *Asymmetrasca*, Madeira, distribuição, plantas hospedeiras, controlo.

INTRODUCTION

Aymmetrasca decedens is a highly polyphagous species which has been recorded as an important pest to several cultivated plants in the Mediterranean region. Recently it has been demonstrated that this species can also transmit phytoplasms to plums and apricots (PASTORE *et al*., 2004; NICOTINA & RAGOZZINO, 1991). This species can become a pest to several fruit trees such as citrus, peaches, and almonds (ABDUL-NOUR, 1985; ALVARADO *et al*., 1994; TORRES *et al*., 1998, 2000), but also damages many other cultivated plants such as cotton, raspberries, potatoes, vines and grain plants (ALTINCAG & AKTEN, 1993; ALVARADO *et al*., 1994; GRASSI & DAL RÌ, 2005; LOUKAS & DROSOPOULOS, 1992).

Damage to plants is caused by feeding: the leaves suffer discoloration but other effects are common also, such as deformation, leaf curling, or necrosis from the apex to the basis of the leaves, usually known as *hopperburn* (ALVARADO *et al*., 1994; JACAS *et al*., 2000; TORRES *et al*., 1998). Deterioration is greater in younger

plants because it reduces the growth of the plant by contraction of the internodes of affected shoots (JACAS *et al*., 2000). As premature defoliation occurs, the plants become weak and often die. Apart from the damage to leaves, fruits such as oranges can also be attacked. On these, the insects cause pale yellow spots, which diminish the quality and the external appearance resulting in the lost of its commercial value (VELIMEROVIC, 1980).

Polyphagous species as *A. decedens* represent a potential problem if they are introduced into new areas because they can shift to new food plants. For example in the case of Madeira, of the seven plant species on which *A. decedens* has been found, six were unknown food plants (FREITAS & AGUIN-POMBO, 2004). Therefore, before establishing plant protection measures it is necessary to know the insect's actual host plant range. Because data on food plants and distribution are much scattered, the present work is a compilation of such information.

MATERIAL AND METHODS

The information was obtained through several electronic bibliographic databases such as CABPESTCD of CAB International, Zoological Record, Agricola, and ISI Current Contents. References were also found in other published papers and entomological journals. Other publications were obtained from specialists working on leafhoppers. The nomenclature of plants follows that of Flora Europaea (TUTIN *et al*., 1964, 1968, 1980).

RESULTS

Food plant records and agricultural importance

It has been recorded from sixty-one plant species of fifty genera belonging to twenty-nine different families (Table 1). These food plants are spontaneous and cultivated plants including ornamental and horticultural plants and fruit trees. However, it is more common on cultivated (77%) than on wild plants (23%), although these data are probably biased because published works are focused mainly on plants of agricultural interest (Fig. 2). About half of its host plants (63%) are herbaceous plants. But *A. decedens* is also associated with trees (30%), and to a lesser extent with shrubs (7%), either deciduous or perennial (Fig. 1).

TABLE 1 - Food plant species of *A. decedens* compiled from literature with their respective common names. The symbol (*) indicates that it has been referred as a pest to that plant species.

FAMILY	SPECIES	COMMON NAME	REFERENCE
Amaranthaceae	*Amaranthus retroflexus* L.	Prince's Feather	26
	Beta vulgaris L.	Beet	3
	Chenopodium album L.	Fat Hen	26
Anacardiaceae	*Schinus molle* L.	Pepper Tree	7
Annonaceae	*Annona cherimola* Mill.	Custard apple tree	5
Apocynaceae	*Catharanthus roseus* (L.) G. Don	Madagascar periwinkle	19
Compositae	*Helianthus annuus* L.	Sunflower	3
	Cichorium intybus L.	Chicory	5
	Cynara cardunculus L.	Artichoke	3; 6
	Dahlia sp.	Dahlia	7
	Jasonia glutinosa (L.) DC.	Rock's Tea	3
	Tagetes minuta L.	Marigold	7
Convolvulaceae	*Ipomoea purpurea* (L.) Roth.	Morning glory	5
Cruciferae	*Brassica oleracea* L.	Cabbage	6; 9
Cucurbitaceae	*Citrullus lanatus* (Thunb.) Matsum. et Nakai	Watermelon	11
	Cucumis sativus L.	Cucumber	6; 29
	Cucurbita pepo L.	Squash	16
Euphorbiaceae	*Ricinus communis* L.	Castor Oil Plant	7; 5
Fabaceae	*Enterolobium cyclocarpum* (Jacq.) Griseb	Elephant's Ear Tree	7
	Glycine max (L.) Merr.	Soy	20
	Medicago sativa L.	Alfalfa	3
	Phaseolus vulgaris L.	Beans	3
	Pueraria montana (Lour.) Merr.	Kudzu	21
	Trifolium sp.	Clover	11
	Vicia faba L.	Bean	27
Fagaceae	*Quercus pubescens* Willd.	Pubescent Oak	1
Juglandaceae	*Carya* sp.	Pecan	28*
Labiatae	*Mentha* sp.	Mint	20
Lamiaceae	*Ocimum basilicum* L.	Basil	20
Liliaceae	*Allium cepa* L.	Onion	11
Malvaceae	*Gossypium hirsutum* L.	Cotton	3
	Lavatera cretica L.	Cretan Hollyhock	7
Moraceae	*Morus alba* L.	Mulberries	14
Oxalidaceae	*Oxalis cernua* Thunb.	Sorrel/Bermuda buttercup	5

(Cont. **TABLE 1**)

Passifloraceae	*Passiflora edulis* Sims	Passion Flower	7
Pedaliaceae	*Sesamum indicum* L.	Sesame	13
Poaceae	*Zea mays* L.	Maize	11
Polygonaceae	*Rumex* sp.	Dock	3
Rosaceae	*Malus domestica* Borkh.	Apple tree	18
	Prunus persica (L.) Batsch	Peach tree	3*
	Prunus domestica L.	Plum tree	23
	Prunus dulcis (Mill.) D.A.Webb	Almond tree	12; 22*
	Prunus armeniaca L.	Apricot	17
	Rubus spp.	Blackberry	26
	Rubus idaeus L.	Raspberry	8*
Rutaceae	*Citrus* sp.	Citric Trees	1*
	Citrus deliciosa Ten.	Mandarin	25
	Citrus sinensis (L.) Osbeck	Orange tree	25
	Citrus limon (L.) Burm.f.	Lemon	4
	Citrus paradisi Macfad.	Grapefruit	4
Salicaceae	*Populus alba* L.	White poplar	10
	Populus nigra L.	Black poplar	15
Solanaceae	*Capsicum annuum* L.	Pepper	5
	Solanum tuberosum L.	Potato	2
	Solanum melongena L.	Egg plant	3
	Solanum nigrum L.	Black Nightshade	26
	Lycopersicon esculentum Mill.	Tomato	6; 24
Umbelliferae	*Foeniculum vulgare* Mill.	Fennel	5
Ulmaceae	*Ulmus* spp.	Elm	26
Vitaceae	*Vitis vinifera* L.	Vineyards	2*
	Vigna unguiculata (L.) Walp.	Cowpea	6; 9

1. Abdul-Nour, 1985
2. Altincag & Akten, 1993
3. Alvarado *et al.* , 1994
4. Baspinar & Uygun, 1992
5. Di Martinho, 1956
6. El Kady *et al.,* 1973
7. Freitas & Aguin-Pombo, 2004
8. Grassi & Dal Rì, 2005
9. Habib *et al.* , 1972
10. Haghighian & Sadeghi, 2001
11. Harakly & Shalaby, 1981
12. James *et al.,* 1997
13. Kersting *et al.,* 1997
14. Khan & Nighat, 1990
15. Koskela *et al.,* 2004
16. Loukas & Drosopoulos, 1992
17. Medina *et al.,* 1981
18. Nestel & Klein, 1995
19. Nicotina & Ragozzino, 1991
20. Pollini & Bariselli, 1995
21. Sun *et al.* , 2006
22. Torres *et al.* , 1998
23. Torres *et al.* , 2000
24. Veierov *et al.* , 1991
25. Velimirovic, 1980
26. Viggiani *et al.* , 1994
27. Viggiani &Guerrieri, 1989
28. Wysoki & Izhar, 1978
29. Yasarakinci & Hincal, 1999

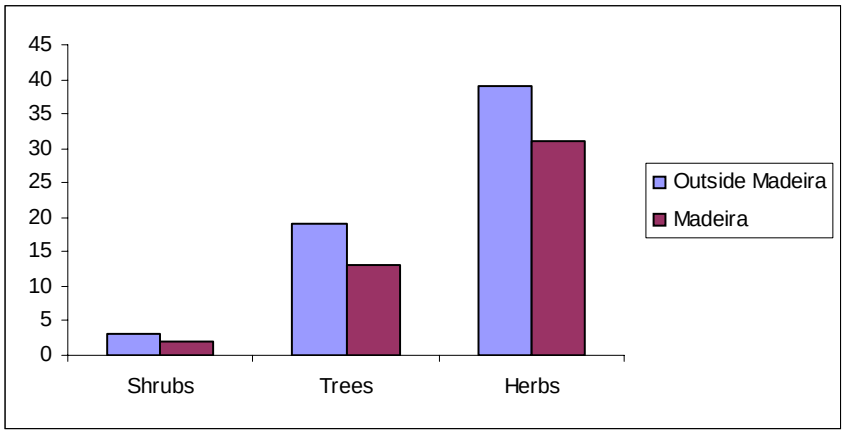

Fig. 1 - Percentage of food plant species of *A. decedens* in Madeira and outside Madeira grouped according to the type of vegetation. Data based on published literature.

The data suggests that in Madeira there are a large number of cultivated plants suitable to be used as hosts. Of all known food plants, forty-six are present in Madeira, representing 75% of all known food plants. Of these plants, most are herbaceous (67%) (Fig. 2), and most of these are horticultural plants (37%) and fruit trees (26%). The lowest proportions are plants used as ornamental, for foraging and florestal species. Among all known food plants present in Madeira particular attention should be given to *Vitis vinifera*, because it is a host plant of this species which is very common in Madeira (Table 1).

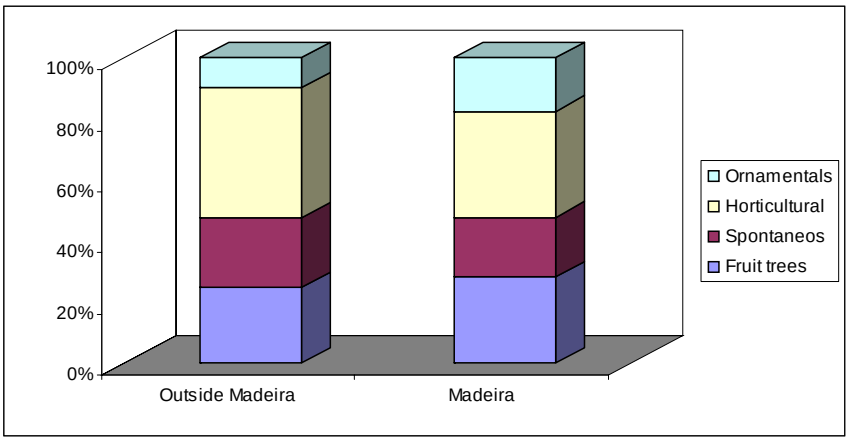

Fig. 2 - Percentage of food plants of *A. decedens* in Madeira and outside Madeira grouped according to spontaneous and cultivated plants. Data based on published literature.

Distribution

Asymmetrasca decedens is distributed widely around the Mediterranean region, where it is believed to be native (ABDUL-NOUR, 1985; ALEKSEEV *et al*., 1976; ASKARI & HUSSAIN, 1977; BASPINAR & UYGUN, 1992; BOVE, 1995; GÜNTHART & MÜHLETHALER, 2002; HERMOSO MENDOZA & MEDINA, 1979; HOLZINGER & SELJAK, 2001; LOUKAS & DROSOPOULOS, 1992; NAST, 1972; RIBAUT, 1936; VELIMIROVIC, 1980). However, it has been recorded also from Middle East countries as Iran (HAGHIGHIAN & SADEGHI, 2001) and Pakistan (DLABOLA, 1971) and also from various western Asiatic countries, including China (CHOU & MA, 1981), North Korea (DWORAKOWSKA, 1970), and India (KHAN & NIGHAT, 1990), which suggests that it is present in a larger area than previously thought. The most likely distribution seems to be between the parallels 40 and 50 from the Iberian Peninsula to China (Fig. 3).

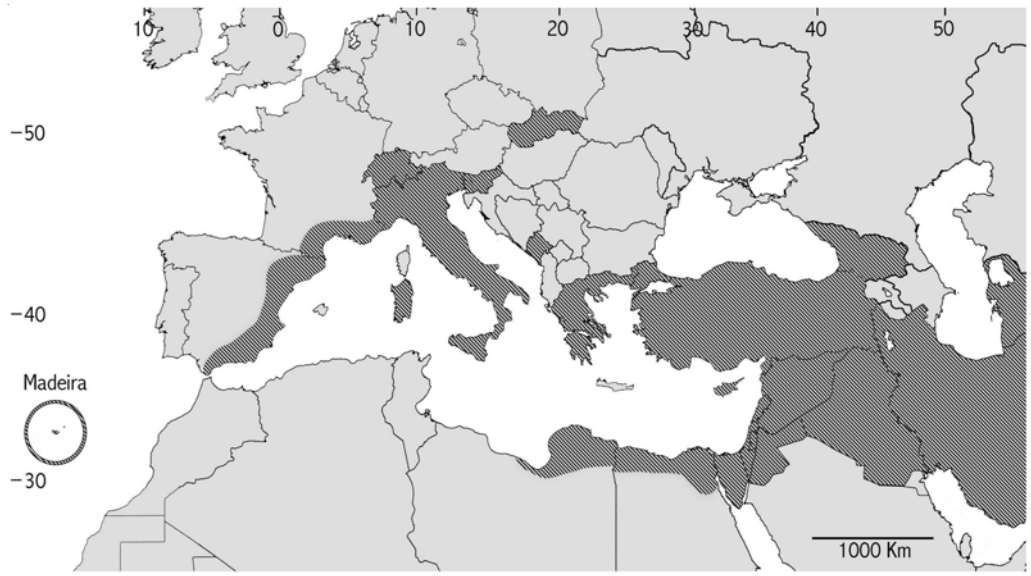

Fig. 3 - Distribution of *A. decedens* in the Mediterranean region.

Management and control

Asymmetrasca decedens has often been reported as a pest from Italy and Spain (JACAS *et al*., 1997; TORRES *et al*., 1998; ALVARADO *et al*., 1994). Populations, which are frequently monitorized by chromotropic traps, are larger in summer (ATAKAN & CANHILAL, 2004; ATAKAN *et al*., 2004; KARUT *et al*., 2005). Chemical control is the most common method of control and several chemicals have been tested (KLEIN *et al*.,

1984; RIGO & MORI, 1997; TUCER *et al*., 2004). The chemicals recommended by agricultural services to control this species affect mainly the nervous system like organophosphates, nicotinoids or pyrethroids but some are insect growth regulator inhibitors. Among the organophosphorus insecticides are recommended several types. In Italy it has been advise for peaches the use of chlorpyrifos-ethyl, phosmet, azinphos-methyl, chlorpyrifos-methyl, thiacloprid and fenitrothion (CAVALLINI *et al*., 2005) and for citrics has been recommended triclorfon, fenitrothion and dimethoate (AGENZIA LUCANA DI SVILUPPO E DI INNOVAZIONE IN AGRICOLTURA, 2003; ASSESSORATO AGRICOLTURA, FORESTE, ALIMENTAZIONE, RIFORMA FONDIARIA, CACCIA, PESCA E ACQUACOLTURA DELLA REGIONE PUGLIA, 2001). In Spain it has been proposed the use of diazinon for almonds to be used together with oil (DEPARTAMENT D'AGRICULTURA, RAMADERIA I PESCA DE LA GENERALITAT DE CATALUNYA, 2006).

Pyrethroid insecticides are also advised. Thus tau-fluvalinat has been advised for almonds in Spain (DEPARTAMENT D'AGRICULTURA, RAMADERIA I PESCA DE LA GENERALITAT DE CATALUNYA, 2006) and etofenprox to be used in citric cultures in Italy (AGENZIA LUCANA DI SVILUPPO E DI INNOVAZIONE IN AGRICOLTURA, 2003). In Italy it has been suggested for cultures of peaches the use of nicotinoid insecticides like imidacloprid, thiacloprid, acetamiprid and thiamethoxan (CAVALLINI *et al*., 2005; UNITA' PERIFERICA PER I SERVIZI FITOSANITARI DELLA REGIONE VENETO, 2005).

Insecticides, which are insect growth regulators inhibitors of chitin synthesis, block the production of chitin so the insect cannot moult and consequently cannot reach the adult stage and reproduce. Insect growth regulators as buprofezine have been proposed to control populations of *A. decedens* in peaches. This insecticide is non systemic and acts by contact and ingestion (ENA, 1997). It has been suggested also the use of the botanical insecticide azadiracthin for peaches and actinidia trees (ALMACELLAS GORT *et al*., 2002) and also margosan-O (MEISNER *et al*., 1992). These compounds are obtained from Nem tree and are potent insecticides with several effects on insects' development and reproduction (MORDUE & NISBET, 2000). An organic insecticide known as Bordeaux Mixture composed of sulphate-copper and calcium hydroxide has been advise for citrics in Sicily with a 2% increase of calcium hydroxide which is believed to act as a repellent for this insect (ASSESSORATO DELL'AGRICOLTURA E DELLE FORESTE, 2003).

It is not known to us any program of biological control for this species. However, it has been suggested as auxiliary fauna coccinelids and *Chrysopa carnea* for appricots, peaches, plumb and nectarines (CONSEJERÍA DE AGRICULTURA, AGUA Y MEDIO AMBIENTE, 2002). In addition it has been found large numbers of mimarids associated with species of *Prunus* in Spain (JACAS *et al*., 2000).

DISCUSSION

Although it was considered that *A. decedens* is a Mediterranean species, the published information show that it has a much broader area of distribution. It is not completely clear whether it is native in all this range or the result of recent introductions but, regardless of this, it is clear that they can use many different food plants and can live in areas with different flora and fauna. This ability to adapt to very different environmental conditions suggests that *A. decedens* has a great potential to colonise successfully new areas. The leafhopper fauna of Madeira is relatively well known; therefore, it seems unlikely that *A. decedens* is native to this island. In fact, previous revisions such as LINDBERG (1961) and latter the recent check-lists by QUARTAU (1993) did not list this species. Moreover, this leafhopper is unknown from other Macaronesian archipelagos and Morocco or even continental Portugal. If this information is accurate, *A. decedens* can have been introduced accidentally in Madeira with ornamental plants through plant trade or otherwise. The fact that populations are small and restricted to a few localities mainly in the southwest of the Island (FREITAS & AGUIN-POMBO, 2004) also supports a recent introduction.

Asymmetrasca decedens has great potential for pest expansion (TORRES *et al*., 1998) and probably also for host range expansion. Indeed, it has a remarkable ability to feed on ornamental plants, many of which have originated in areas or even continents different from those of its actual area of distribution (see Table 1). There are some reasons to believe that *A. decedens* can become a problem for the agriculture in Madeira. The main reason to believe this is that more than 70 % of its hosts are present in Madeira, and about 40% of these are common economically important plants. Most of them, like *Citrus* spp, *Prunus persica* and *Prunus domestica* (ABDUL-NOUR, 1985; ALVARADO *et al*., 1994; TORRES *et al*., 1998), are widely cultivated fruit trees of Madeira. This damage would be greater if the insect attacks subtropical fruit trees as passion fruit, *Passiflora edulis*, a traditional culture where it has been already found. Apart from these main cultures, other extensively cultivated horticultural plants like tomatoes, beans, potatoes and strawberries could also be at risk. In addition, many of its host plants are cultivated as ornamentals, nowadays a promising commercial product for exportation. Nevertheless, the most worrying situation is that this species feeds also on *Vitis vinifera* (ALTINCAG & AKTEN, 1993) and this is one of the main cultures in the Island.

Considering that Madeira has a large number of suitable host plants and suitable climatic conditions to complete several annual generations (FREITAS & AGUIN-POMBO, 2004; TORRES *et al*., 2002; HABID *et al*., 1972), the potential risks from this species need to be carefully evaluated. Chemical control is effective and a large number of products are available. However, any future actions undertaken to control this species

should take into consideration that wild plants like *Ricinus communis* or *Lavatera cretica* could be a suitable refuge and that this insects shows great resistance to normal insecticides (RIGO & MORI, 1997). In addition to this, insecticides seem to cause this leafhopper to migrate to other common spontaneous wild plants (NESTEL & KLEIN, 1995; TORRES *et al*., 1998). The potential damage to endemic plants should also be considered. Monitoring these leafhoppers' populations is necessary but measures to avoid the accidental introduction of undesired organisms like this should be also undertaken.

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