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ON THE SUDDEN APPEARANCE AND SPREAD OF THE BLACK CITRUS APHID *Toxoptera citricidus* (KIRKALDY), (HOMOPTERA: APHIDOIDEA) ON THE ISLAND OF MADEIRA

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with 1 Figure

ABSTRACT: The black citrus aphid, *Toxoptera citricidus,* was introduced into Argentina during the nineteen-thirties and rapidly spread throughout the region. This aphid is an effective vector of the Citrus Triteza Virus which was responsible for the death of millions of orange trees in South America. *Toxoptera citricidus* was first recorded in Madeira during January 1994 and efforts to eradicate it were unsuccessful due to the extremely rapid dissemination throughout the citrus growing areas of the island. The implications are discussed and details of the aphid's host range, biology, field identification and symptoms of the attack are given. The results of the ELISA tests for Citrus Tristeza Virus gave negative results for citrus material tested from both the aphid infested and non infested areas.

Key words: *Toxoptera citricidus*, Citrus Tristeza Virus, Madeira Island

RESUMO: Após ter sido introduzido nos anos trinta na Argentina, o afídeo negro dos citrinos, *Toxoptera citricidus*, tem avançado lentamente e sem oposição em direcção ao hemisfério norte. Em Janeiro de 1994 verificou-se o aparecimento súbito desta espécie na Ilha da Madeira, facto que poderá originar vários problemas cujas implicações são discutidas. Os esforços para erradicá-la não foram bem sucedidos devido à sua rápida disseminação pelas áreas citrícolas da ilha. São apresentados dados sobre hospedeiros, biologia, reconhecimento no campo e sintomatologia do ataque. Amostras de citrinos

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colhidas tanto em áreas infestadas como não, foram sujeitas a testes ELISA para detecção do Vírus da Tristeza dos Citrinos, tendo os resultados sido negativos.

Palavras chave: *Toxoptera citricidus*, Virus da Tristeza dos Citrinos, Ilha da Madeira.

INTRODUCTION

The black citrus aphid *Toxoptera citricidus* (KIRKALDY), also known as the tropical citrus aphid, oriental black citrus aphid and brown citrus aphid (CARVER, 1978), is an effective vector (SAMSON, 1980) of the Citrus Tristeza Virus (CTV). This aphid is widespread in Africa south of the Sahara, South East Asia and Oceania (BLACKMAN & EASTOP, 1989). In the nineteen-thirties it appeared in Argentina and quickly spread throughout the subcontinent and more recently to the Caribbean. This resulted in a massive CTV epidemic which killed millions of citrus trees in the region (AUBERT et. al., 1992).

ILHARCO (1974) reported the presence of *Toxoptera aurantii* (B. DE FONSCOLOMBE) in Madeira, and latter forewarned of the dangers of *T. citricidus* getting a foothold on the island (ILHARCO & FONSECA, 1985). In January 1994, during a routine inspection for CTV in Madeiran citrus orchards, two colonies of *T. citricidus* were identified in the Funchal area. Immediate steps to eliminate the aphid and halt its spread were unsuccessful.

T. citricidus lives almost exclusively on Rutaceae, mainly *Citrus* spp. and relatives like *Severinia, Murraya, Calodendrum, Choisya, Eremocitrus* and *Geijera.* Occasionally it may form colonies on *Malpighia punicifolia, Azalea* and more rarely on Rosaceae, Meliaceae, Moraceae and Oxalidaceae. (AUBERT et. al., 1992; CARVER, 1978; ILHARCO & FONSECA , 1985). In Madeira, for the moment it was only found on Rutaceae, mainly *Citrus* species.

As *T. aurantii* is also found in Madeira, the casual observer could easily confuse this species with *T. citricidus.* However, the apterae of *T. citricidus* are medium sized, generally > 2 mm long whereas those of *T. aurantii* are shorter, < 2mm; both have similar colouring, very dark brown to black and an overall shiny appearance. The easiest way to distinguish the alatae of *T. citricidus* from those of *T. aurantii*, is by observing of the fore wing details. *T. citricidus* has a pale pterostigma and the median vein is divided twice whereas the alatae of *T. aurantii* have a very dark pterostigma and the median vein is divided once. The abdomen of *T. citricidus* is shiny and black, but that of *T. aurantii* is mat dark brown to black. Scrutiny of the third antenna segment will reveal that on *T. citricidus* it is thick and dark whilst on *T. aurantii* it is thinner and pale in colour. The colonies of *T. citricidus* are much more dense with a darker overall appearance than those of *T. aurantii.*

T. citricidus can develop large colonies on the young growth of the host plants and also on the lower surface of the leaves along the veins. The feeding process of these large colonies can cause distortion and rolling of leaves, stunting of shoots and twigs. The abundance of excreted honeydew attracts ants and can serve as medium for sooty moulds.

They can even feed on young flowers causing serious bud drop. HILL (1987) states that heavy infestations may regularly produce a yield loss of up to 50%.

This species is entirely anholocyclic breeding through constant viviparity and parthenogenesis. It prefers moist and warm climates like that of the island of Madeira and can apparently tolerate colder conditions than *T. aurantii* thus reaching higher altitudes in the island. In optimal developing conditions, four generations can be completed in one month which gives some idea of its latent spreading power (BLACKMAN & EASTOP, 1989; HILL, 1987).

The black citrus aphid, *T. citricidus* is a very efficient vector of CTV and is able to transmit the most severe strains of the virus (GARNSEY & LEE, 1989). Tristeza is a graft and aphid transmissible disease caused by a threadlike virus particle of the Closterovirus type. CTV is the most economically important pathogen of citrus production world-wide. More than 100 millions trees on sour orange rootstock have been killed throughout the world by new and severe strains of CTV which have been dispersed to new areas by *T. citricidus* (ROISTACHER, 1993).

CTV infects nearly all species, cultivars, and intergeneric hybrids of citrus and some citrus relatives. The only non-rutaceous genus known to be infected is *Passiflora.* Symptom expression in citrus hosts is highly variable and affected by environment, host species, scion-rootstock combinations and the severity of the isolate. Stunting, stem pitting, leaf cupping, vein clearing, chlorosis and reduced fruit size are common symptoms (GARNSEY & LEE, 1989).

The presence of CTV in any citrus producing region is a matter of great concern due to the high risk of spreading the disease. Infected scions worked on sour orange are particularly vulnerable and it should be noted that sour orange is the favoured rootstock for Madeira. Fortunately citriculture is not the most economically important crop in Madeira, but should a CTV epidemic occur the financial and social implications for the farming community would be grave.

MATERIAL AND METHODS

Bearing in mind the danger of this situation, an extensive survey was done on citrus orchards throughout the island. Field observations were done for the detection of Tristeza symptoms on lemon, sweet orange, tangerine, citron, mandarin and the following rootstocks: sour orange, *Poncirus trifoliata,* Troyer citrange and Carrizo citrange. ELISA tests were run on samples of these plants from all the municipalities of Madeira (Map 1) and processed at the Laboratório Agrícola. The 420 samples collected were tested against the standard CTV polyclonal antibody obtained from commercial kits.

All the slide mounts and samples in ethanol are deposited in the insect collection of

the Laboratório Agrícola da Madeira (ICLAM) and are identified by code numbers beginning by the letter "A" (e.g. A270). The localisation of collecting sites on the distribution maps is based in Universal Transverse Mercator (U.T.M.) coordinates (e.g. CB0417). The maps themselves are a reduction of the 1/25.000 topographic chart of the island of Madeira.

MATERIAL STUDIED:

Bom Sucesso, Funchal, CB2215 (12 Jan. 94, A270, *Citrus medica*, col. A. Fernandes); Quebradas, Funchal, CB1613 (13 Jan. 94, A272/274 *Poncirus trifoliata* & *Citrus aurantium*, col. F.AGUIAR); S° da Ribeira, St^a Cruz, CB3118 (14 Mar. 94, A300b, *Citrus sinensis*, col. F. AGUIAR); St^a Cruz (Town), CB3217 (21 Mar. 94, A308b, *Citrus sinensis*, F. AGUIAR); S° dos Moinhos, St^a Cruz, CB2815 (6 Apr. 94, A322b, *Citrus sinensis*, col. P. de CARVALHO); Garajau, Caniço, CB2612 (9 Apr. 94, A327, *Citrus limon*, col. A. FERNANDES); S° do Pedregal, C^a de Lobos, CB1315 (28 Apr. 94, A358, *Citrus limon*, col. F. AGUIAR); S° do Saraiva, C^a de Lobos, CB1514 (28 Apr. 94, A362, *Citrus limon*, col. F. AGUIAR); Quebradas, Funchal, CB1613 (28 Apr. 94, A364, Citranger Troyer, col. F. AGUIAR); Preces, C^a de Lobos, CB1414 (28 Apr. 94, A365/368, *Citrus limon* & *C. sinensis*, col F.AGUIAR); S° D. Mécia, St^a Cruz, CB3218 (10 May 94, A380/385, *Citrus sinensis* & *C. reticulata*, col. M. CORREIA); S° da Morena, St^a Cruz, CB3119 (10 May 94, A390, *Citrus limon*, col. A. FERNANDES); S° da Têrça de Cima, St^a Cruz, CB3319 (10 May 94, A394, *Citrus sinensis*, col. A. FERNANDES); S° das Eiras, St^a Cruz, CB3219 (10 May 94, A402, *Citrus sinensis*, col. F. AGUIAR); S° da Igreja, Campanário, CB1016 (17 May 94, A397/403, *Citrus sinensis* & *C. reticulata*, col. Z. VASCONCELOS); S° do Jogo da Bola, S. Jorge, CB2232 (24 May 94, A411, *Citrus medica*, col. Z. VASCONCELOS); S° doMoreno, Rib^a Brava, CB0816 (7 Jun. 94, A424, *Citrus limon*, col. G. FREITAS); Ponta Delgada, CB1433 (8 Jun. 94, A429, *Citrus sinensis*, col. A. FERNANDES); Lombo de S. João, Ponta do Sol, CB0319 (13 Jun. 94, A439, *Citrus limon*, col. F. AGUIAR); Rosário, S. Vicente, CB1028 (14 Jun. 94, A447/448, *Citrus reticulata* & *C. sinensis*, col. F. AGUIAR); S° da Igreja, Campanário, CB1016 (14 Jun. 94, A450, *Citrus sinensis*, col. A. MEXIA); S° do Barreiro, Santana, CB2331 (14 Jun. 94, A452/454, *Citrus sinensis* & *C. limon*, col. P.de CARVALHO); Achada do Marques, Santana, CB2130 (14 Jun. 94, A457, *Citrus limon*, col. A. MEXIA).

RESULTS

During February no colonies of the pest were observed, but the onset of spring and warmer conditions promoted new citrus growth and the sudden reappearance of large colonies in almost all the orchards visited. These colonies had large numbers of alatae which, no doubt, facilitated the rapid dissemination of the pest. The presence of *T. citricidus* on the northern

part of the island, which is separated by a central mountain chain, can be attributed to the carrying of alatae over the mountains by convectional air currents rising from the deep valleys. Six months after the initial outbreak *T. citricidus* was recorded at 22 locations in seven of the island's ten municipalities of Madeira (Map 1), from sea-level to about 450 meters.

None of the physical symptoms of Tristeza was observed on the citrus samples collected and all gave negative results using the ELISA tests, thus suggesting that the virus may not be present on the island.

CONCLUSIONS

The presence of *T. citricidus* in Madeira could pose a very serious threat to citrus growers should CTV infected trees exist or indeed be introduced. Furthermore, the island's citrus production is particularly vulnerable as a high proportion of the trees are grafted onto CTV susceptible sour orange rootstocks. To pre-empt or at least contain a CTV epidemic the following steps should be initiated.

Rootstock research: The following rootstocks are reported (HARTMAN & KESTER, 1959; SAMSON, 1980) to be either resistant or tolerant to CTV; Carrizo citrange, Cleopatra mandarin, Rough lemon, Swingle citrumelo and *Poncirus trifoliata*. The performance of these rootstocks has not been thoroughly evaluated under Madeiran conditions; rootstock trials should be started immediately.

Biological control studies: Already parasitoids (Aphidiidae) had been observed on *T. citricidus* colonies but the level of parasitism appears to be low; however, efficacy could probably be enhanced by the mass production of beneficials.

Plant phytosanitary controls: With the obvious increase in the importation of plants to Madeira it will be necessary to strengthen the phytosanitary services inspection capability at all points of entry on the island.

CTV surveys: With the CTV vector now firmly established on the island it will be imperative for surveys to be done on a regular basis. To ensure this adequate budget provision must be made annually.

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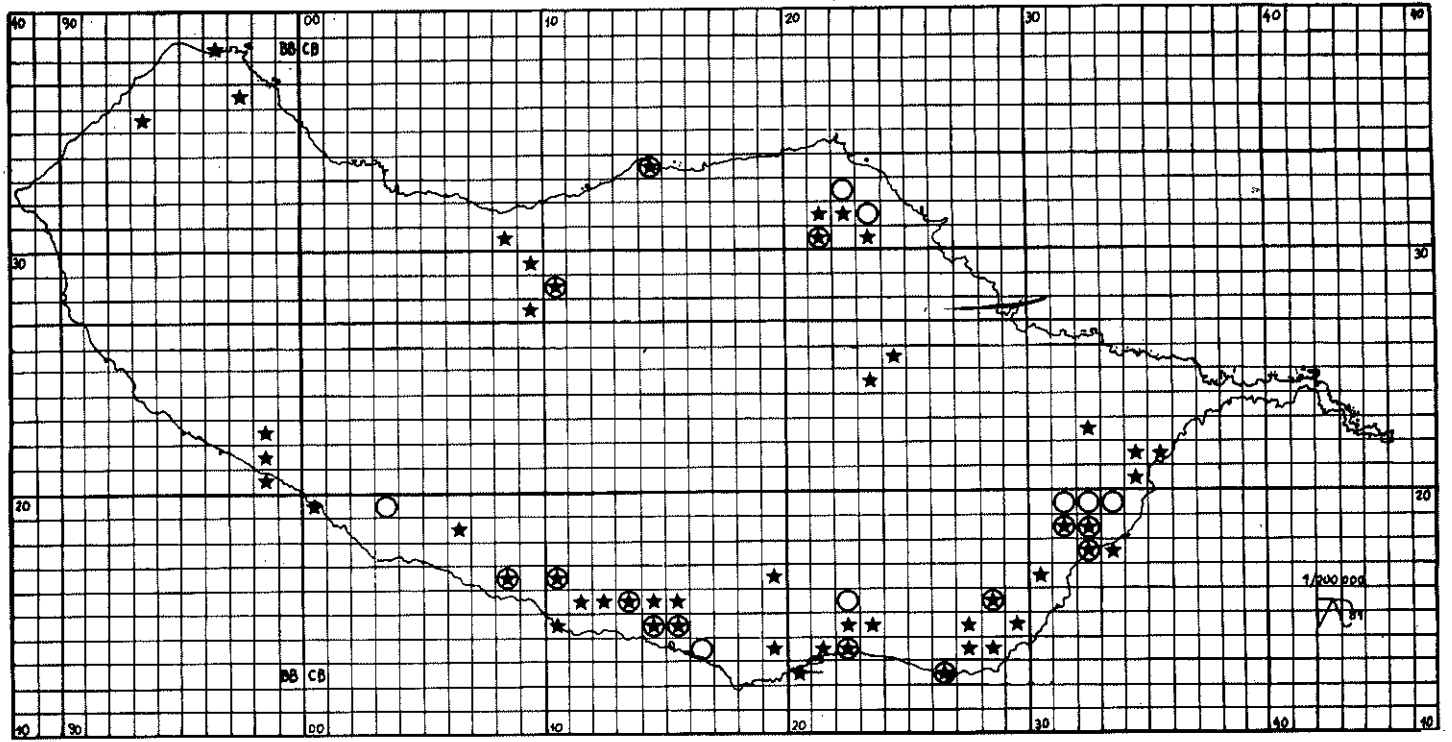

Fig. 1 - Map showing the sites where *T. citricidus* were observed (o) and where tests for CTV on citrus were carried out (*).

REFERENCES

AUBERT, B.; ETIENNE, J.; COTTIN, R.; LECLANT, F.; Ph. CAO VAN; VUILLAUME, C.; JARAMILLO, C. & BARBEAU, G.:

1992. Citrus Tristeza Disease a new threat for the Caribbean Basin. Report of a survey to Colombia, Dominican Republic, Guadeloupe, Martinique and Trinidad. *Fruits* **47** (3): 393-404.

BLACKMAN, R. L.& EASTOP, V. F.:

1989. *Aphids on the World's Crops. An Identification Guide*. John Willey & Sons (Eds), 446 pp.

CARVER, M.:

1978. The black citrus aphids, *Toxoptera citricidus* (Kirkaldy) and *T. aurantii* (Boyer de Fonscolombe) (Homoptera: Aphididae).*J. Aust. ent. Soc.* **17**: 263-270.

GARNSEY, S. M.& LEE, R. F. :

1989. *Tristeza* in *Compendium of Citrus Diseases.*WHITESIDE, J. O. *et.al.* (Eds), APS PRESS, 2nd Edition, 80 pp.

HARTMAN, H.T. & D.E. KESTER:

1959. *Plant Propagation - Principles and Practices*, Prentice-Hall, Inc., Engleweed Cliffs, New Jersey, 2nd edition. pp. 575-581.

HILL, D. S.:

1987. *Agricultural insect pests of the Tropics and control*. Cambridge University Press, 2nd Edition, 746 pp.

ILHARCO, F.:

1974. List of the Aphids of Madeira Island (Homoptera, Amphidoidea). *Bocagiana*, **35**: 1-44.

ILHARCO, F. A.& P. A. FONSECA:

1985. *Identificação de afideos por via macroscópica.* 1. *Afideos dos Citrinos.* Edição INIAER, Lisboa.

ROISTACHER, C. N.:

1993. Arguments for establishing a mandatory certification program for citrus. *Citrograph*, **78** (12): 8-10.

SAMSON, J.A.:

1980. *Tropical Fruits*. Longman Group Limited, London. pp. 64-118.

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