

JOURNAL OF NATURAL HISTORY, 1997, 31, 1261-1272



An introduced new species of *Lecanoideus* (Homoptera: Aleocharidae) established and causing economic impact on the Canary Islands*

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(Accepted 15 December 1996)

Lecanoideus floccissimus sp. n. is described from material collected in the Canary Islands and Ecuador. A review of the economic impact of *L. floccissimus* in the Canary Is. is presented. The status of *Lecanoideus* Quaintance and Baker is discussed. Keys are provided to enable adults and puparia of *L. floccissimus* to be distinguished from *Aleurodicus dispersus* Russell, which is also established on the islands.

Se describe *Lecanoideus floccissimus* sp. n. a partir de material procedente de las Islas Canarias y Ecuador. Se discute el estatus del género *Lecanoideus* Quaintance et Baker y se aporta una clave para distinguir *L. floccissimus* de *Aleurodicus dispersus* Russell, especie también perteneciente a la subfamilia Aleurodicinae y establecida en las Islas Canarias. Se presenta una breve revisión del impacto económico producido por la nueva especie *L. floccissimus* en las Islas Canarias.

Introduction

Aleurodicus dispersus Russell (1965), often known as the Spiralling Whitefly, has been known from the Canary Is. since 1962, when it was first noticed colonising *Schinus terebinthifolius* (Russell, 1965; Martin, 1996).

From 1991 onwards agriculturalists in the Canary Is. noticed a great increase in whitefly problems, thought to be caused by *A. dispersus*, affecting many species of ornamental and shade trees and tropical crops. Although an increasing number of recorded host plants would not be unusual for *A. dispersus*, which is known to be highly polyphagous (Russell, 1965), this whitefly had hitherto only been a minor problem on the Canaries (Manzano *et al.*, 1995). *A. dispersus* has been under the effective natural control of parasitoids in the Canaries, and yet densely flocculent colonies of whiteflies have now become the most important insect pests in gardens all over the coastal areas of Tenerife, posing an economic threat to tropical plants of economic importance, such as banana and mango.

The unexpected increase in the level of damage caused by these extremely woolly agglomerations of whiteflies raised suspicions that a second species may be involved. Subtle differences were noticed between the colonies causing problems on Tenerife and populations from other islands in the Canaries. The presence of a second species has been confirmed, and is identified as an undescribed species of the New World

genus, *Lecanoideus*. It co-exists with *A. dispersus*, often on the same plants and even the same individual leaves.

Direct feeding damage is caused by the enormous populations depriving plants of sap and thus inhibiting growth. The excretion of copious amounts of honeydew causes a secondary problem with sooty mould forming on the upper surfaces of leaves which underlie colonies of whiteflies: this can reduce effective photosynthesis, and the unsightly appearance renders ornamentals unsaleable. A further irritation to local people is the fluffy white 'wool', secreted by the larval stages, which blows from trees, sticks to clothing and garden furniture, and even causes allergic reactions in some people.

Spraying with detergents and contact insecticides has proved ineffective. Further, this new pest is very common in private gardens, where use of more powerful pesticides poses a threat to human health. Investigations are underway to determine a strategy which addresses this problem.

The purposes of this communication are to describe this new insect pest, to discuss its taxonomic position and to facilitate its recognition in comparison with the similar *Aleurodicus dispersus*.

Depositories

BMNH—The Natural History Museum, London SW7 5BD, UK.

CDFA—Plant Pest Diagnostics Center, California Department of Food and Agriculture, Sacramento, California 95832, USA.

ICIA—Instituto Canario de Investigaciones Agrarias, E-38200 La Laguna, Tenerife, Spain.

USNM—US Department of Agriculture, Beltsville, Maryland 20705, USA (*perpro* United States National Museum of Natural History, Washington DC).

Lecanoideus flocissimus sp. n.

Appearance in life

Larval body colour yellowish but whole colony normally completely obscured by copious white wax, which is punctuated by thick curls and also by long coarse strands secreted by large compound pores (Plate 1). The adults are completely white in appearance and are often hidden under the colony's waxy secretion, and contributing to it. Dense colonies completely cover the lower surfaces of many leaves and white fluff floats off at the slightest disturbance.

Morphology

The following description uses terminology detailed by Russell (1965), Martin (1987) and Gill (in Gerling, 1990).

Puparium (Fig. 4). Margin down-curved at least slightly, but this is variable and some specimens have the margin much deflexed and folded-under when mounted on slides: true margin smooth (Fig. 4a), but where this is deflexed apparent margin very irregular (Fig. 4b). Puparia 1.00–1.41 mm long, on slides their outline and width varying with degree of marginal deflexion, often appearing rather flattened anteriorly.

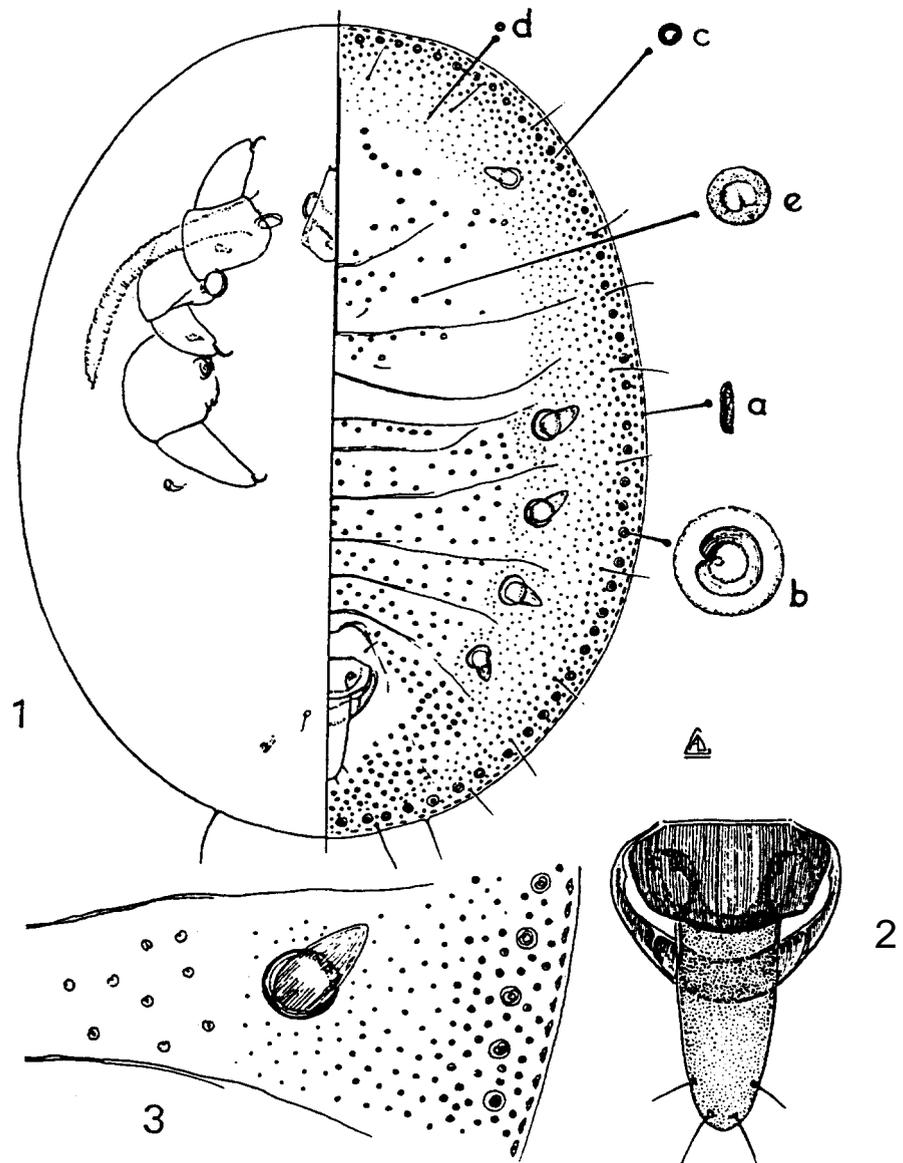
Dorsum. Vasiform orifice, operculum and lingula as figured. Cuticle posterior to vasiform orifice, underlying lingula, smooth and without a median cleft or furrow.



PLATE 1. Habitat photograph of a single puparium of *Lecanoideus floccissimus* on banana in Tenerife (E. H-Suarez).

Chaetotaxy. Posterior marginal setae over $100\mu\text{m}$ long, anterior marginals absent; inner submargin with 12 pairs (including the nominal caudal pair) of long, fine setae, variable, to over $100\mu\text{m}$; single pairs of similar posterior-cephalic, meso- and meta-thoracic and eighth abdominal setas.

Pores. Cephalic and four abdominal pairs of large compound pores present, cephalics usually $30\text{--}35\mu\text{m}$ and abdominals usually $40\text{--}50\mu\text{m}$ in diameter, their pointed central processes almost invariably directed posteromesad in slide-mounted material. In addition abdominal segment VIII with very small compound pores ($10\text{--}20\mu\text{m}$) inconsistently present near the median line, posterior to the vasiform orifice: around 50% of specimens with a pair of pores, 40% with a pore on one side only and 10% are without (72 examined). Submargin comprises a broad zone of crowded wide-rimmed simple pores (Fig. 4c, d) which extend mesad as shown by dashed line: towards the puparial margin the wide-rimmed pores become gradually smaller, and closest to the margin their appearance becomes different as they present a more lateral aspect. Submedian cuticle smooth and punctuated only by ovoid septate pores as shown, distinctly clustered adjacent to abdominal compound pores and vasiform orifice.

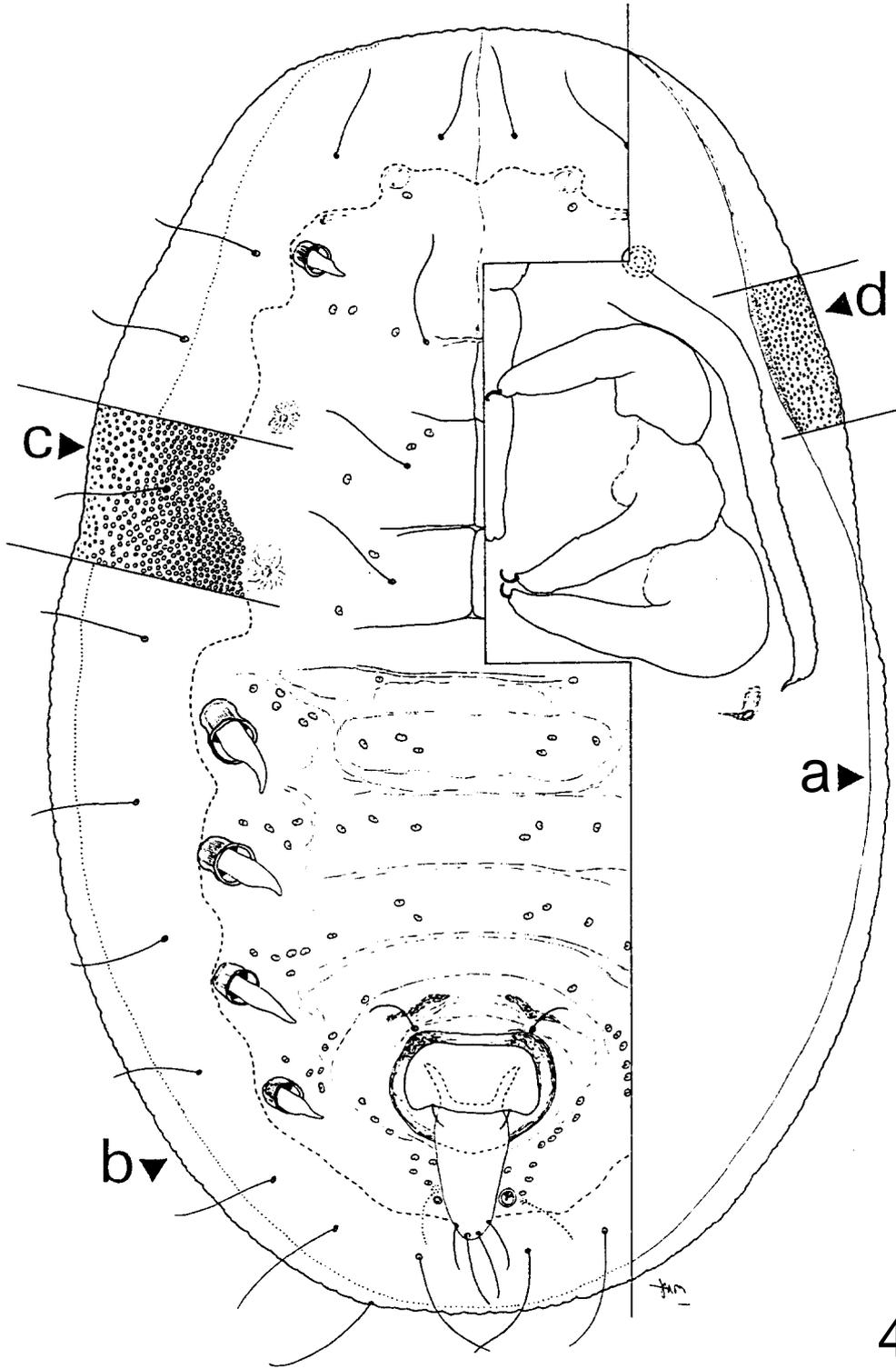


FIGS. 1-3. *Aleurodicus dispersus*, pupa. (1) dorsal and ventral halves of body; a, 8-shaped pore; b, double-rimmed pore. c, wide-rimmed pore; d, minute wide-rimmed pore; e, septate pore. (2) vasiform orifice. (3) portion of dorsal surface of abdominal segment 4. (Drawings by Arthur D. Cushman.)

Venter. As shown (Fig. 4); antennae very long, almost reaching back to anterior abdominal spiracle; ventral abdominal setae up to $75\ \mu\text{m}$ long, situated posterior to vasiform orifice (depicted as pair of dotted lines in figure).

Adults (Figs 5-12)

Antennae 7-segmented, segment III much the longest and very little shorter than segments IV-VII added together. Wings as shown (Figs 5, 6), without pigmentation. Dorsal surface of vertex (Fig. 7) with a shallow trough between the ocelli; some



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specimens appear to have a small median ocellus. between the normal lateral pair (see *Species discussion*).

Adult ♂ (Figs 8, 9). 2.70–3.70 mm long, including the claspers (parameres) which are 0.73–1.05 mm and which comprise 0.25–0.30 of the insect's total length. Claspers (Fig. 9) of simple structure, 2.38–3.16 x length of aedeagus. Aedeagus 0.28–0.36 mm long, up-curved, its apical opening a slightly thickened rim which appears dorsally tooth-like in lateral aspect (Fig. 8). Ultimate rostral segment 0.20–0.22 mm long.

Adult ♀ (Figs 10, 11). 2.55–3.10 mm long. Abdomen as shown; a finger-like dorso-median process present posterior to lingula, appearing spatulate in dorsal view; posteriormost two pairs of ventro-lateral wax-secreting plates with their surfaces smooth or irregularly corrugate, not reticulate. Ultimate rostral segment 0.22–0.24 mm.

Type material examined

. HOLOTYPE pupal case—Canary Is., Tenerife, Santa Cruz de Tenerife, 26 May 1996, on *Ficus* sp. (Moraceae), E. Hernandez-Suarez (BMNH). PARATYPES—Canary Is., Tenerife, 78 puparia, 6 third instar larvae, 23 ♂♂, 5 ♀♀, same data as holotype with some specimens from additional host plants *Ficus bengalensis* and *Strelitzia nicolai* (Strelitziaceae); 3 puparia, 2 ♂♂, 3 ♀♀, Santa Cruz, 08 December 1995, on 'laurel de Indias' (*Ficus microcarpa*), E. Hernandez-Suarez; 1 puparium, 2 ♂♂, 4 ♀♀, San Juan, 30 November 1994, on *F. microcarpa*, E. Hernandez-Suarez (BMNH, CDFA, ICIA, USKM); 21 puparia, 4 ♂♂, 1 ♀, Adeje, 23 November 1993, on *Musa acuminata* 'platanera', E. Hernandez-Suarez (ICIA); **Ecuador**, S puparia, Napo Coca, January 1982 and December 1983, on *Elaeis guineensis* (Palmae) and unidentified palm, G. Onore (BMNH); leaves with dried specimens attached, **Canary Is.**, Tenerife, data as above (BMNH, ICIA): 10 dissected adult heads (2 cavity slides) + dissected abdomens, 3 ♀♀, 3 ♂♂ (1 slide), same data as holotype (BMNH).

Non-type material examined

Trinidad. 33 puparia, ?1995, on *Coccoloba uvifera* (Polygonaceae), V. Lopez (BMNH).

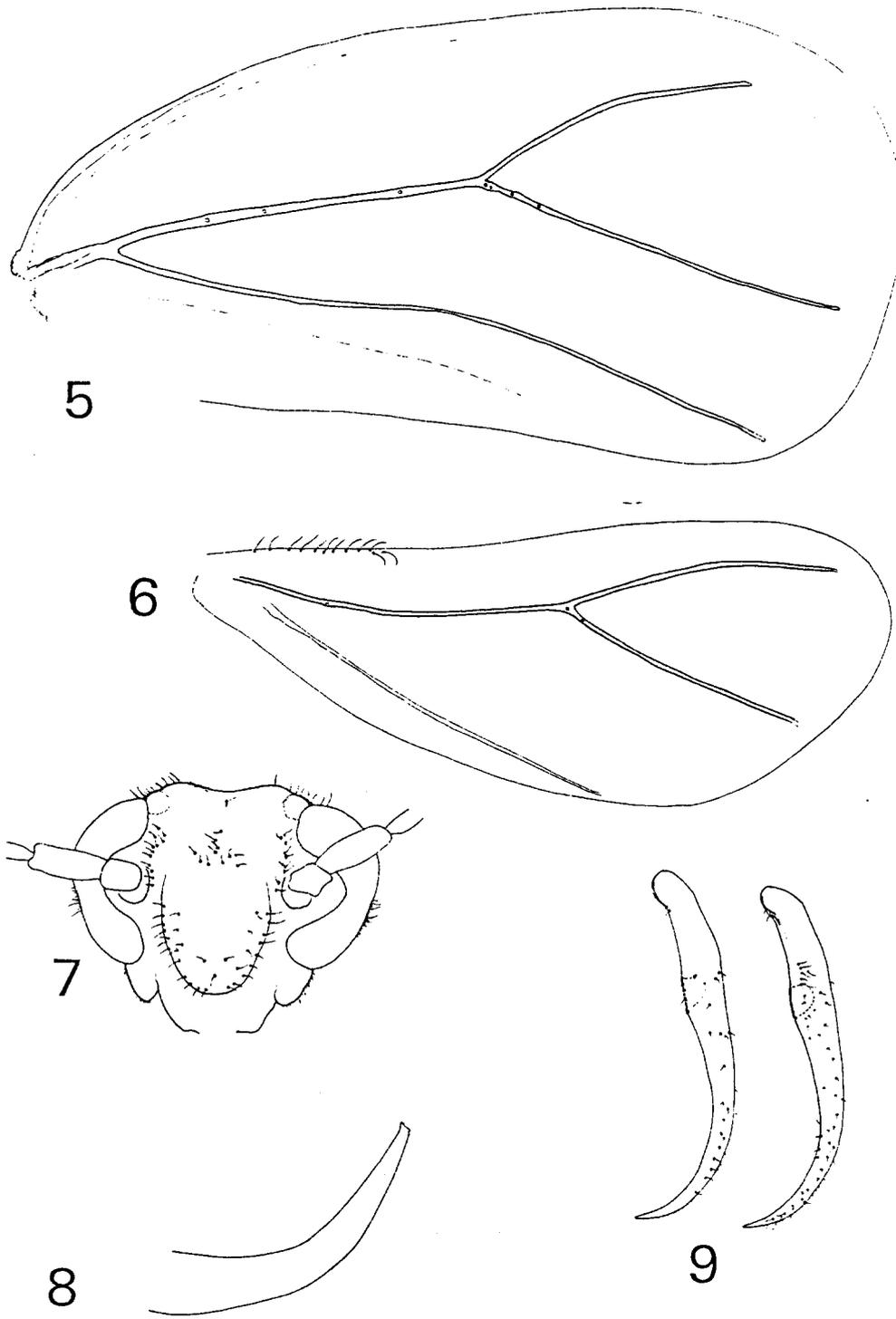
Host plants and distribution in the Canaries

At the time of writing *L. floccissimus* has only been found on the island of Tenerife, always near the coast (see *Type material examined*). Here, it is already known from 40 plant species, within 30 genera and 17 families, as detailed below. It should be noted that several of these records refer to exotics which are not listed in recent Macaronesian floras, such as Hansen and Sunding (1985), Kunkel (1986) or Bramwell and Bramwell (1990).

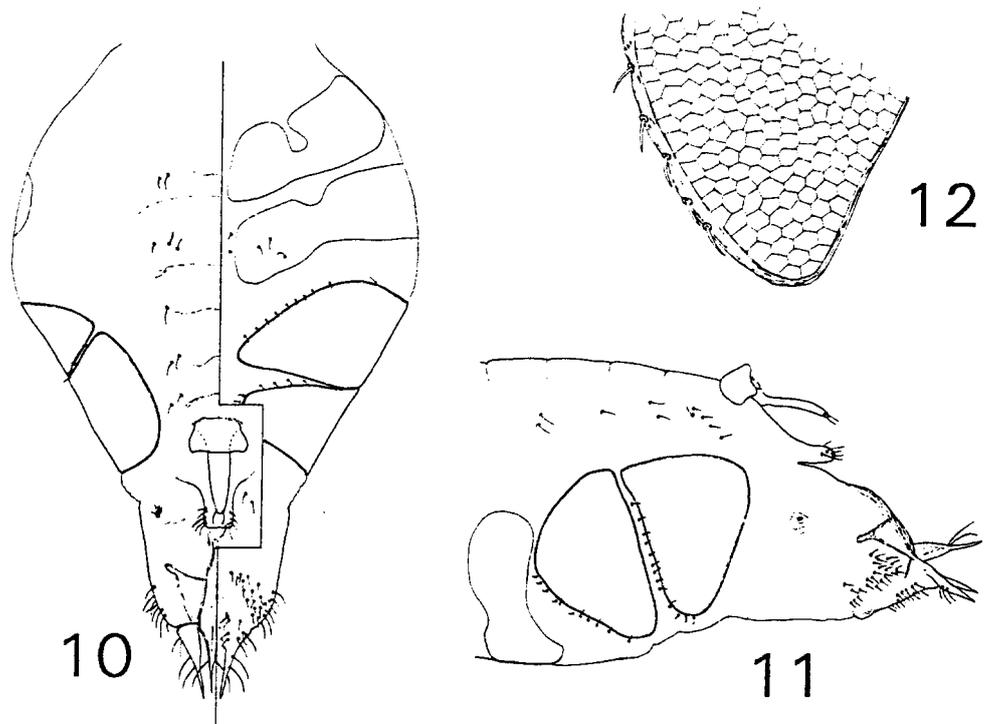
AGAVACEAE

Yucca aloifolia

Fig. 4. *Lecanoideus floccissimus*, puparium. Dorsal detail left of division line, extent of deflexed margin shown as dotted line, ventral detail to right: (a) true margin; (b) apparent margin where true margin deflexed; (c) detail of submarginal wide-rimmed pore zone (dorsum), zone boundary continued as dashed line; (d) detail of submarginal wide-rimmed pore band (venter).



FIGS 5-9. *Lecanoideus floccissimus*, adults: (5) forewing, ♂; (6) hind wing, ♂; (7) head, ♀, frontal view with probable median ocellus shown; (8) aedeagus, ♂, lateral view of apex; (9) clasper, ♂, ventral (left) and dorsal (right) views.



FIGS 10–12. (10,11) *Lecanoideus floccissimus*, adult ♀; (10) abdomen, dorsal (left) and ventral (right); (11) abdomen, lateral view of posterior segments. (12) *Aleurodicus dispersus*, adult ♂; glandular structure of posteriormost two pairs ventro-lateral abdominal plates.

ANACARDIACEAE

Mangifera indica

Schinus terebinthifolius

APOCYNACEAE

Acokanthera oblongifolia

Nerium oleander

CARICACEAE

Carica papaya

COMBRETACEAE

Terminalia catappa

DRACAENACEAE

Dracaena draco

EUPHORBIACEAE

Acalypha wilkesiana

Euphorbia pulcherrima

CAESALPINIACEAE

Burhinia variegata

Malvaceae

Hibiscus rosa-sinensis

Malva viscosa penduliflora

MORACEAE

Ficus benjamina, *F. elastica*, *E. lyrata*, *E. macrophylla*, *F. microcarpa*, *F. rubiginosa*

MUSACEAE

Musa acuminata, *Musa* sp
Strelitzia nicolai, *S. reginae*

MYRTACEAE

Psidium guajava

PALMAE

Arecastrum romanzoffianum
Brahea armata
Chrysalidocarpus (Areca) lutescens
Cocos nucifera
Howea forsteriana
Livistona chinensis var. *chinensis*
Mascarena verschaffeltii
Phoenix dactylifera, *P. canariensis*, *P. roebelinii*
Washingtonia filifera, *W. robusta*

POLYGONACEAE

Coccoloba uvifera

PROTEACEAE

Stenocarpus sinuatus

RUTACEAE

Citrirs aurantium

VERBENACEAE

Lantana camara

Natural enemies

In the Canaries, although a species of *Encarsia* [*E. ?hispidata* De Santis, A Polaszek, personal communication] (Hymenoptera, Aphelinidae) is known to parasitise *A. dispersus*, no parasitoid has yet been discovered affecting *L. floccissimus*. However, several of the puparia of *L. floccissimus* from Ecuador have emergence holes and parasitoid remains present, indicating a likely source of bio-control agents if such an approach is adopted. In the Canaries, a species of *Scymnus* (Coleoptera, Coccinellidae) is predatory upon both *A. dispersus* and *L. floccissimus*.

Generic discussion

The subfamily Aleiroidicinae is in great need of revised generic definitions. Such a study will need to involve an appraisal of both adult and larval stages as well as the examination of all available type material. Such a study is beyond the scope of this bulletin, but brief discussion of the status of *Lecanoideus* is necessary here.

Quaintance and Baker (1913) proposed *Lecanoideus* as a subgenus of *Aleurodicus* Douglas (in Horgan, 1892). Costa Lima (1928) raised it to a full genus, without any taxonomic discussion, when referring to Brazilian material identified as *L. giganteus* (Quaintance and Baker, 1913). There has been no subsequent discussion and Mound and Halsey (1978) accepted Costa Lima's use of *Lecanoideus* as a full genus, in their world catalogue of Aleyrodidae. Neither of the two hitherto included species, *L. giganteus* and *L. mirabilis* (Cockerell, 1898) has achieved a level of importance that warranted further nomenclatural discussion of the genus in the literature.

For adults, Quaintance and Baker (1913) used the 'bilobed' vertex of the head to distinguish *Lecanoideus* from *Aleurodicus sensu stricto*, but adults were anyway

only available for study in the case of *L. giganteus*. Adults of *L. floccissimus* do have a slight trough on the dorsal part of the vertex, between the paired ocelli (Fig. 7). Adults identified as *L. giganteus* (BMNH) have a similar but deeper trough, but Quaintance and Baker's (1913) original drawing of *L. giganteus* appears to be exaggerated. Otherwise adults of *Aleurodicus sensu stricto* and *Lecanoideus* are extremely similar, and puparial characters appear somewhat more satisfactory. For puparia, Quaintance and Baker (1913) used the deflexed margin, combined with the absence of 'reduced' compound pores in the vicinity of the vasiform orifice, to diagnose *Lecanoideus*. The puparium of *L. floccissimus* displays a variable degree of marginal deflexion, but does usually have at least one small compound pore present posteriorly. A few species accommodated within *Aleurodicus sensu stricto* (most notably *A. dispersus* Russell and *A. coccolobae* Quaintance and Baker) also lack small, posterior abdominal compound pores, and this particular character cannot be regarded as diagnostic for *Lecanoideus*.

It is considered here that the three species *giganteus*, *mirabilis* and *floccissimus* comprise a definite species-group, characterised by the following combination of puparial features: margin down-curved and often deflexed to a varying degree; submargin with a very wide zone of crowded simple pores of only the wide-rimmed type; abdominal large compound pores with central processes that are usually directed posteromesad in slide-mounted examples; when small compound pores present posterior to the 4 large abdominal pairs then only on segment VIII. It is felt that *Lecanoideus*, comprising these three species, is best retained here as a full genus pending more detailed taxonomic studies on the Aleurodicinae, especially since subgenera are rarely used in whitefly systematics. Such studies should particularly involve further appraisal of adult characteristics.

Species discussion

L. floccissimus is distinguished from the other two species of *Lecanoideus*, and indeed from most members of the Aleurodicinae, by its usual presence of small compound pores near the median line of abdominal segment VIII of the puparium, posterior to the vasiform orifice, with segment VII always without such pores. Also, the puparium of *L. floccissimus* does not possess a short median furrow/cleft, posterior to the vasiform orifice and underlying the lingula; such a furrow/cleft is present in type specimens of *L. giganteus* and *L. mirabilis* in USNM (S. Nakahara, personal communication) and in material provisionally identified as *L. giganteus* in BMNH. The degree of marginal deflexion is less in *L. floccissimus* than described in *L. giganteus* and *L. mirabilis*, but greater than in species of *Aleurodicus s. str.* In the adult, the vertex has a shallower dorsal trough in *L. floccissimus* than in *L. giganteus*; adults of *L. mirabilis* have not been described.

Several slide-mounted adults of *L. floccissimus* clearly possess what appears to be a small third ocellus between the normal lateral pair (Fig. 7). In many slide-mounted specimens it is difficult clearly to see the detail of this part of the head, and dry specimens have the cuticle obscured by wax. Nonetheless it appears also that some specimens do not possess this extra ocellus. Gill (in Gerling, 1990) reported that, in the Aleyrodidae, only species of *Paraleyrodes* were believed to possess a third ocellus, but in a recent personal communication he reports that this characteristic has been seen in some specimens of species of *Aleurodicus s. str.*; examination of a number of specimens in BMNH, displayed in favourable aspect, confirms this. Its apparent presence in *L. floccissimus* is certainly of interest.

The discovery of 8 slide-mounted specimens of *L. floccissimus* from Ecuador in BMNH slide accessions is important because it confirms an initial assumption that it is a New World species, introduced into the Canary Is. *Aleurodicus dispersus* is another species which secretes substantial amounts of white wax: its presence in the Canaries may therefore have obscured the initial arrival of *L. floccissimus* and it is thus not possible to establish exactly when that may have occurred.

A sample of 23 puparia from *Coccoloba uvifera* (Polygonaceae) was submitted to the CAB International Institute of Entomology from Trinidad in 1996. These specimens are very similar to *L. floccissimus* but differ subtly: they bear many fewer ovoid septate pores on the dorsal disc, and these are not clustered adjacent to the large abdominal compound pores; whilst the anteriormost three pairs of abdominal compound pores are similar in size to those of *L. floccissimus*, the cephalic and fourth abdominal pairs are considerably smaller, about 22–28 μm . It is not certain whether or not these represent intraspecific variation, and they are not included in the type series of *L. floccissimus*.

Identification of Aleurodicinae in the Canary Islands

Only *L. floccissimus* and *Aleurodicus dispersus* are currently established in the Canary Islands. *A. dispersus* is highly polyphagous and *L. floccissimus* is already known from a wide range of host plants on Tenerife (see above) so that host plant data cannot aid their recognition. These two species may, however, be distinguished by use of the following keys. Other members of the Aleurodicinae currently in Europe are keyed in Martin (1996)

Puparia

- 1 Outer submarginal zone with a distinct ring of double-rimmed pores (Figs 1b, 3); dorsal disc mesad of compound pores densely punctuated by septate pores (Figs 1e, 3) as shown. Pupal case <1.25 mm long. *Aleurodicus dispersus* Russell
 - Outer submarginal zone without a ring of such double-rimmed pores; dorsal disc mesad of compound pores sparsely punctuated by septate pores (Fig. 4). Pupal case often 1.25 mm or longer (33 out of 72 examined). *Lecanoideus floccissimus* sp.n.

Adults

- 1 σ parameres usually 0.5–0.65 mm long, <2.5 x length of aedeagus. Female abdomen with post-lingular median process apically rounded when viewed from above; posteriormost two pairs of ventro-lateral abdominal plates with distinct reticulate pattern (Fig. 12). *Aleurodicus dispersus* Russell
 - Male parameres 0.73–1.05 mm long, 2.38–3.16 x length of aedeagus. Female abdomen with post-lingular median process apically spatulate when viewed from above (Fig. 10); posteriormost two pairs of ventro-lateral abdominal plates without reticulate pattern (Figs 10, 11). *Lecanoideus floccissimus* sp.n.

Acknowledgements

We are indebted to Steve Nakahara (USNM) for scanning the US National Collection for possible material of this new species, and for commenting on type material of *L. giganteus* and *L. mirabilis*. Ray Gill (CDFA) kindly offered helpful opinions on an early draft of this paper. The help of colleagues at ICIA, especially Isabel Palacios, Luis Rumeu and Alfredo Reyes (who carried out much collection of study material), is also acknowledged with thanks.

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