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Morphometric variation in the *Geoica utricularia* (Homoptera: Aphididae) species group on *Pistacia* (Anacardiaceae), with descriptions of new species and a key to emigrant alatae

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Abstract. Variation within and between samples of emigrant alatae from galls on identified *Pistacia* species was studied using bivariate and multivariate techniques. The *Geoica utricularia* complex seems to include at least five taxa, including two newly identified; *G.utricularia* Passerini sensu stricto, on *Pistacia terebinthus*; *G.muticae* Mordvilko, on *P.mutica*; *G.rungsi* Davatchi & Remaudière, on *P.atlantica*; *G.harpazi* sp.n., also on *P.atlantica*; and *G.wertheimae* sp.n. on *P.palaestina*. The emigrant alatae of the two new species are described, together with apterous exules reared from them, and a key is provided to emigrant alatae of all eight *Geoica* species now known to induce galls on *Pistacia*. The taxonomic status of anholocyclic, grass-feeding populations in the *Geoica utricularia* group is discussed.

Introduction

Aphids of the genus *Geoica* (Pemphiginae: Fordini) form leaf galls on *Pistacia* trees (the primary host) in the Mediterranean region and south-west and south Asia. They have a complex 2-year life-cycle that includes migration to and from Gramineae (their secondary host), where all-female (thelytokous) populations feed on the roots. The *Pistacia*-galling and grass-root-feeding forms of the same species are very different morphologically and have been in some cases originally described in different genera.

Populations can persist throughout the year on roots of Gramineae, and such populations occur outside the range of *Pistacia*. For example, aphids identified as *G.utricularia* (Passerini, 1856), a species originally described from *Pistacia terebinthus* in Italy, occur commonly on roots of cereals and grasses in central and northern Europe and in North America. *G.utricularia* presents a particularly difficult taxonomic problem. The name *G.utricularia* has been applied to all populations with numerous short, dispersed hairs on the anal plate, but the root-feeding populations in Europe and North America vary greatly in other aspects of chaetotaxy (number of hairs on ultimate rostral segment, eighth abdominal tergite, cauda, presence or absence of spatulate hairs), and karyotype (Blackman & Eastop, 1984).

Aphids currently regarded as *G.utricularia* occur on *Pistacia* species other than *P.terebinthus*. Populations on *P.mutica* in the Crimea and on *P.atlantica* in the Mediterranean area are currently regarded as a subspecies of *G.utricularia* (*muticae* Morvilko, 1928), and there are consistent electrophoretic differences perhaps indicative of sibling species, between populations of '*utricularia*' on *P.atlantica* and *P.palaestina* in Israel (Koach & Wool, 1977).

Thus the name *utricularia* is apparently being applied at present to a complex including species and subspecies on *Pistacia* and thelotokous (anholocyclic) races on cereals and grasses. Eastop & Hille Ris Lambers (1976) regarded *G.utricularia* as one member of 'a group of species not yet fully understood' and it is this *G.utricularia* group of species which is the main subject of this paper.

In this paper we report on a multivariate study of available samples of emigrant alatae to see whether these group according to the species of *Pistacia* from which they were collected. We recognize new *Geoica* species within the *utricularia* group, specific to *P.atlantica* and *P.palaestina*, and discuss the relation between the *Pistacia*-feeding generations and those on secondary host plants.

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Materials and Methods

The study was based on material from the following depositories: The Natural History Museum, London (BMNH); Israel National Insect Collection, Tel Aviv University (INIC), and the Museum National d'Histoire Naturelle, Paris (MNHN). Material studied for morphometric analyses consisted of alate emigrants from galls of known species of *Pistacia* from France, Italy, Morocco, Israel and Iran. Using the assumption that alatae inside one gall are the offspring of one fundatrix and so represent a single clone, up to ten specimens were measured from forty-four galls (378 specimens, Table 1) using a Kontron Videoplan interactive measuring system. Measurements were made according to the methods illustrated in Ilharco & van Harten (1987). Eighteen characters used previously in the taxonomy of *Geoica* were selected (Table 2) and measured for each specimen (Davatchi & Remaudière, 1957; Wool & Koach, 1976; V. F. Eastop, unpublished data).

To investigate host-related differences in general morphology, canonical variate analyses (CVA) were carried

Table 1. Samples of *Geoica utricularia* species group measured.

Sample no.	Host	Locality	Date	No. of measured specimens		Karyotype
				Migrants	Exules	
DHRL F87	*P.terebinthus*	France	19.ix.1959	10	8 (grass)	
DHRL F89	*P.terebinthus*	France	25.ix.1959	10		
Leclant 727	*P.terebinthus*	France	4.viii.1964	7		
Feltwell 19281	*P.terebinthus*	France	viii.1981	4		
DHRL 833	*P.terebinthus*	Italy	22.ix.1973	10		
DHRL 836	*P.terebinthus*	Italy	22.ix.1973	10		
DHRL 837	*P.terebinthus*	Italy	22.ix.1973	10		
VFE 14330	*P.terebinthus*	Italy	x.1973	10		
VFE 14331	*P.terebinthus*	Italy	x.1973	6		
Tremblay	*P.terebinthus*	Italy	x.1973	–	2	
RLB 1467	*P.terebinthus*	Sicily	20.x.1977	4		2n = 18
RLB 1911	*P.terebinthus*	Crete	16.viii.1979	–		2n = 21
Talhouk 57	*P.terebinthus*	Lebanon	1.xi.1972	10		
Bodenheimer	*P.palaestina*	Israel	20.x.1949	5		
Remaud. 1669	*P.palaestina*	Cyprus	24.x.1962	10		
DHRL 844	*P.palaestina*	Israel	5.xi.1973	10		
DHRL 845	*P.palaestina*	Israel	5.xi.1973	10	5	
RLB 155	*P.palaestina*	Israel	13.xi.1974	5		
RLB 157	*P.palaestina*	Israel	13.xi.1974	9		2n = 18?
RLB 160	*P.palaestina*	Israel	13.xi.1974	10		2n = 18
RLB 161	*P.palaestina*	Israel	13.xi.1974	7		
RLB 164	*P.palaestina*	Israel	13.xi.1974	10		2n = 18
RLB 167	*P.palaestina*	Israel	13.xi.1974	10		2n = 18?
Davatchi P36	*P.mutica*	Iran	ix.1957	6		
Remaud. i673	*P.mutica*	Iran	28.vi.1955	10 + 10		
Remaud. i1173	*P.mutica*	Iran	20.vi.1955	8		
Remaud. i1261	*P.mutica*	Iran	20.x.1955	6		
Remaud. 0492a	*P.atlantica*	Morocco	24.x.1954	4		
Remaud. 0965a	*P.atlantica*	Morocco	ix.1957	10 + 7		
Remaud. 0965b	*P.atlantica*	Morocco	ix.1957	10		
Remaud. 0988a	*P.atlantica*	Morocco	28.ix.1957	5		
Remaud. 0988c	*P.atlantica*	Morocco	28.ix.1957	10		
Remaud. 0988f	*P.atlantica*	Morocco	28.ix.1957	10 + 10		
VFE 14332	*P.atlantica*	Israel	x.1973	10		
RLB 158	*P.atlantica*	Israel	12.x.1974	10		
RLB 163	*P.atlantica*	Israel	12.x.1974	10		2n = 18?
RLB 168	*P.atlantica*	Israel	12.x.1974	10		
DHRL 838	*P.atlantica*	Israel	4.x.1973	10		
DHRL 839	*P.atlantica*	Israel	4.x.1973	10		
DHRL 842	*P.atlantica*	Israel	4.x.1973	10		
DHRL 843	*P.atlantica*	Israel	4.x.1973	10		
DHRL 862	*P.atlantica*	Israel	12.x.1974	5		
VFE 14333	*P.atlantica*	Israel	x.1973	10		
RLB 162	*P.atlantica*	Israel	12.x.1974	10		