PHENOLOGY, POPULATION TREND AND NATURAL ENEMIES OF
ALEUROTHRIXUS FLOCCOSUS (HOM.: ALEYRODIDAE) AT A NEWLY
INVADED AREA IN ATHENS, GREECE

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The woolly whitefly Aleurothrixus floccosus (Maskell) (Homoptera: Aleyrodidae) seems to originate in Central and South America (Mound & Halsey, 1978). In the Mediterranean region, it was first noticed on the French Riviera and in Malaga, Spain, in 1966 (Onillon, 1969; Moreno Vasquez, 1973). Then its dispersion was reported, in Morocco by 1973 (Abbassi & Onillon, 1973), in Portugal by 1977 (Silva Magalhaes, 1979), and in Italy by 1980 (Liotta, 1982; Ortu, 1983). A. floccosus invaded Greece, possibly in late 1990; it was first discovered infesting citrus trees in eastern urban areas of Athens, in May 1991 (Katsoyannos, 1991).

The invasion of Greece by A. floccosus was considered a serious threat for the following reasons: 1) there was little hope of eradication, considering the failures of previous whitefly
eradication attempts by chemical means, as in the cases of *A. floccosus* in California, *Aleurocanthus woglumi* Ashmead in Cuba and Mexico, *Dialeurodes citri* (Ashmead) in California and *Aleurocanthus spiniferus* (Quaintance) in Japan (De Bach & Rose, 1976); 2) the wool-like wax filaments which cover 3rd and 4th instar nymphs and pupae of *A. floccosus* impede penetration of insecticides; 3) the use of toxic insecticides could not be advised in urban areas of Athens, because of the risk of side effects damaging to human health; and 4) the invader pest was spreading rapidly in Greece, heavily infesting citrus trees.

The originally Central American hymenopterous parasitoid *Cales noacki* Howard (Aphe- linidae) was introduced into France in 1971, Spain in 1973, Portugal in 1977 and Italy in 1980 for inoculative biological control of *A. floccosus*. In all of these countries, the whitefly populations were successfully reduced (Onillon, 1973; Vulic & Beltran, 1977; Carrero, 1979; Silva Magalhaes, 1979; Liotta & Maniglia 1983). In 1991, a colony of *C. noacki* from Valencia, Spain, was imported by the first author and multiplied in the insectary, in preparation for releases in the field against *A. floccosus* (Katsoyannos, 1991).

This work began in 1991, after *A. floccosus* was discovered in eastern Athens. It initially aimed to study the phenology of *A. floccosus*, to monitor the dynamics of its infestation levels and to investigate the presence, if any, and possible importance of native natural enemies. From 1992, when the first releases of *C. noacki* were made, until 1994, the effect and importance of the introduced parasitoid in the field were also studied, for acquiring information needed to develop suitable strategies for integrated control of *A. floccosus* in Greece. In addition, rearing tests were conducted in the laboratory in 1992 and 1994 to check the suitability of *A. floccosus* as prey for the coccinellid (Coleoptera) predator *Clitostethus arcuatus* (Rossi).

**MATERIALS AND METHODS**

The field work for these studies was conducted on sour orange trees, *Citrus aurantiun* L., grown in a park and in rows along the streets of the urban area of Zographou, Athens, to the west of Mount Hymitos in Attica, central Greece. Samples and data on the phenology of *A. floccosus*, its infestation level on sour orange trees and the effect of its natural enemies were collected in 1991-1995 at the Zographou park.

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Samples of 48 leaves (1 apical, 1 from the middle of a twig and 1 basal, taken from each quadrant — north, south, east and west — of 4 marked trees) were collected weekly from the park during the warm period of the year and twice per month during the winter, without prior consideration of their infestation level. The leaves were examined in the laboratory. The number of eggs, and *A. floccosus* nymphs living and parasitized were recorded; infestation level was calculated, and expressed as number of living *A. floccosus* nymphs per cm² of leaf surface.

To check on voltinism, one hundred adults of *A. floccosus*, collected from the Zographou park trees on August 2, 1991, were reared in 1992, in a cylindrical plexiglass cage (35 cm in diameter, 70 cm in length) placed outdoors near the laboratory of the Benaki Institute, Kifissia, Athens. They were provided with a sour orange seedling for feeding and oviposition. When the first colonies of nymphs were noticed, the seedling was removed from the cage and shaken, in order to oust all living parental adults; the seedling, containing nymphs only, was then returned to the cage. The first 100 adults (approximately) to emerge were