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Trials of biological control of *Aonidiella aurantii* Maskell (Hemiptera, Coccoidea) in citrus groves in Italy

Abstract - The Authors report the results of field trials that assessed the potential of biological control of California red scale *Aonidiella aurantii* Maskell in citrus groves, using *Aphytis melinus* DeBach. The trials, performed under the P.O.M. project (Multi-regional operative project) A36, were carried out in 1999 - 2000 in five farms: three located in Sicily and two in Calabria. In each farm, three lots of 1 ha were established, two of which biologically treated and one acted as the control. Monitoring of *A. aurantii* male flight was achieved using California Citrus I.P.M.-type traps (one per lot) that were checked weekly and the dispensers were replaced monthly. Releases, six in all, started in April and continued to September, each time releasing 20,000 specimens/ha, for a total of 120,000 *Aphytis*/year/ha. The parasitization was assessed on 1 m of branches about 1 cm in diameter, taken from 4 plants within each lot, at the time of the third and sixth releases, and observing the specimens present. On commercial ripening, we assessed the percentage of infested fruits out of 100 fruits per treatment and the percentage of parasitization out of 500 scale specimens counted on 100 fruits picked from 5 infested plants. Data underwent statistical analysis (ANOVA). Results revealed no statistically significant differences in the treatments. In 60% of cases the percentage of fruits infested by the armoured scale were higher in lots in which *A. melinus* adult were released, with values varying between 39 to 77% in 1999 and 25 to 37% in 2000. On branches and fruits taken from these lots, in 2000, the parasitization rates were higher than those in the control areas (varying between 29.37 % to 46.84 %). Also in relation to the different levels of infestation of the trees, the parasitic activity of *A. melinus* was insufficient to limit damage by *A. aurantii* within economically viable limits.

Key words: *Aphytis melinus*, augmentative release, armoured scale.

INTRODUCTION

The California Red Scale (CRS) *Aonidiella aurantii* Maskell is an important pest in citrus groves world-wide (Ebeling, 1959). In Italy it was recorded at the beginning of the twentieth century, but it was present only in restricted areas of Campania, Puglia, Lazio and Liguria regions. Since the sixties CRS spread in all citrus areas of Southern Italy (including major islands and Calabria) (Liotta, 1970; Longo & Russo, 1986) and

causes heavy damage on fruits and plants if not controlled (Longo *et al.*, 1994). Insecticides are usually used to reduce CRS population density, but with the aim to restrict insecticide use, under the P.O.M. project (Multi-regional operative project) A36, the alternative tactic of releasing *Aphytis melinus* De Bach (Hymenoptera Aphelinidae) has been proposed according to I.P.M. methodology (Luck *et al.*, 1997; Moreno and Luck, 1992) to CRS biological control.

MATERIALS AND METHODS

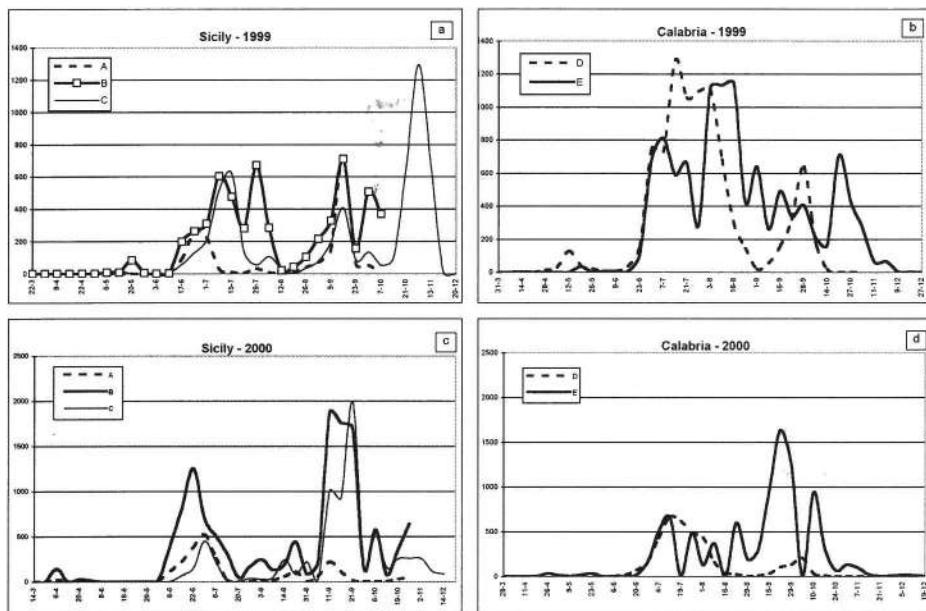
The trials were carried out in 1999 - 2000 in five citrus-groves: three located in Sicily (A, B, C) and two in Calabria (D, E). In each orchard, three lots of 1 ha were established, two of which biologically treated and one acted as control. Monitoring of *A. aurantii* male flight was achieved using California Citrus I.P.M.-type traps (one per lot) that were checked weekly; the sex pheromone dispensers were replaced every four weeks. Meteorological data, that were used also to measure thermal time in Degree-Day, were given by Technical Assistance Centres of both Regions (S.O.A.T. in Sicily and C.E.D.A. in Calabria). Releases, five or six in all, started in April (when temperature allowed the survival of *Aphytis* and CRS populations were mainly represented by 2nd instars and young females) and continued to September; each time releasing 20,000 parasitoids/ha, for a total of 100,000 -120,000 *Aphytis*/year/ha. On commercial ripening, we assessed the percentage of infested fruits out of 100 fruits per treatment and the percentage of parasitization out of 500 scale specimens counted on 100 fruits picked from 5 infested plants. Data underwent statistical analysis (ANOVA).

RESULTS

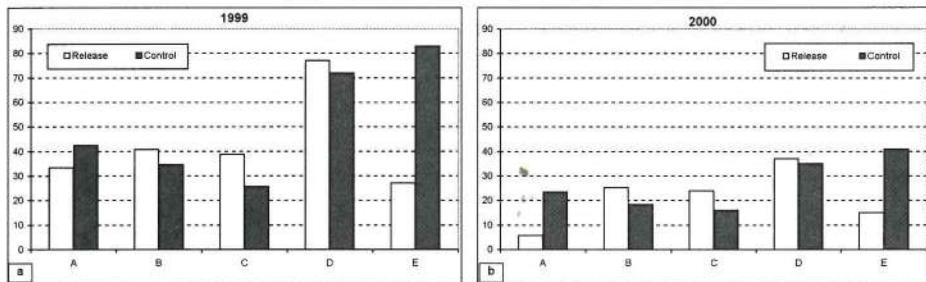
The graph 1 shows CRS male captures in the first and second years of observations in Sicily and Calabria citrus groves. The flight patterns accurately reflect development in CRS generation: there were normally three-four peaks of male captures starting from April-May until October according to the three entire generation and one incomplete that normally occur in our country.

Degree-Day calculation, starting from January of each year, shows that the first peak occurred normally after the accumulation of 243 DD and the second one, concerning the first generation after the overwintering one (occurring in June-July) after 627-969 DD (average 720 DD). During the other generations, scale stages began to overlap and male flights appear continuous.

Results revealed no statistically significant differences in the treatments. In 60% of cases the percentage of fruits infested by the armoured scale was higher in lots in which *A. melinus* adult were released, with values varying from 39 to 77% in 1999 and 25 to 37% in 2000 (Graphs 2). On fruits taken from these lots, in 2000, the parasitization rates were higher than those in the control areas (varying from 29.37 % to 46.84 %) (Graphs 3).



Graph. 1 - Male captures of *Aonidiella aurantii* during 1999 (a, b) and 2000 (c, d) in Sicily (groves A, B, C) and Calabria (groves D, E)



Graph 2 - Percentage of infested fruits on commercial ripening in the five citrus groves in Sicily (groves A, B, C) and Calabria (groves D, E) during 1999 (a) and 2000 (b).

DISCUSSION

The parasitic activity of *A. melinus* in our country is linked to the action of various factors: the different levels of infestation of the trees, the different kind of groves, the small size of the farms that doesn't allow to release the wasp on wide areas, and, not least, the antagonistic behaviour of ants towards *Aphytis* (Tumminelli *et al.*, 1997). In Southern Italy, *A. melinus* is insufficient to limit damage by *A. aurantii* within economically acceptable limits.