BIOLOGICAL CONTROL OF THE MEDITERRANEAN BLACK SCALE, *SAISSETIA OLEAE* (HOM. : COCCIDAE) IN ISRAEL

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During the years 1975-1982, the “Israel Cohen” Inst. for Biological Control conducted a biological control project, against the black scale, *Saissetia oleae* (Olivier) (Homoptera : Coccidae). Seventeen species of natural enemies were introduced into Israel during that period, and their action reduced the populations of the pest to an acceptable level. The major parasitoid responsible for that transition was *Metaphycus bartletti* Annecke & Mynhardt (Hymenoptera : Encyrtidae). This article describes the project and introduces some notes on the biology of the introduced parasitoids.

KEY-WORDS : parasitoid, biological control, release of beneficial arthropods.

The black scale, *Saissetia oleae* (Olivier) has a wide distribution, including Israel. It originated probably in South Africa where it is parasitized by numerous natural enemies (Smith & Compere, 1928). De Lotto pointed out the southern parts of the Cape Province of South Africa as the center of origin of this species (De Lotto 1976).

*S. oleae* was found in Israel in 1912 on olive trees (Mendel, 1980) and first recorded as a pest in 1920 (Bodenheimer, 1924). It became prominent in 1965 on olives and secondarily on citrus (Peleg, 1965). It became a major pest of citrus throughout the Coastal Plain and Yizrael Valley in the early ’70s (Podoler et al., 1979).

*S. oleae* is thelytokous and polyphagous. Rare males were recorded only in California (Ebeling, 1959). The pest infests leaves and twigs, sucks the tree sap and produces large amounts of honeydew which serves as a substrate for sooty mold fungi; the latter interfere with photosynthetic and respiratory processes of the plant. Thus yield decreases and fruit is rejected for export. The pest was traditionally controlled in Israel by oil sprays or carbamate pesticides. It has a number of annual generations, depending on the host plant and climatic conditions. On non-irrigated olives and citrus it has one annual generation whereas on irrigated olives it has 2 generations (Blumberg et al., 1975; Peleg, 1965). On oleander plants in greenhouses it produces 2-3 generations (Podoler et al., 1979; Ishaaya & Swirski, 1976). On potato seedlings under controlled conditions it has 4-5 generations.

Numerous natural enemies of the black scale were recorded from Israel prior to 1976. These are: *Diversinervus elegans* Silvestri (Encyrtidae), *Scutellista caerulea* (Fonscolombe) (Pteromalidae), *Moranila californica* (Howard) (Pteromalidae), *Metaphycus zebratus* (Mercet) (Encyrtidae), *Microterys flavus* (Howard) (Encyrtidae), *Diversinervus cervantesi* (Girault) (Encyrtidae) and *Bothriophyne fuscicornis* Compere (Encyrtidae), (Mendel et al., 1984; Rosen, 1962, 1967; Rosen & Alon, 1983; Rosen et al., 1971).
These natural enemies did not control the pest effectively. Most parasitoids attacked the "rubber" stage (preovipositing female) and the ovipositing female when most of the damage had already occurred. None of these natural enemies parasitized the young female of *S. oleae* which is the most damaging stage, and the need for such natural enemies was evident (Mendel, 1984; Podoler *et al.*, 1979).

**MATERIALS AND METHODS**

**REARING OF *S. OLEAE* AS A LABORATORY HOST FOR PARASITOIDS**

The black scale was reared under controlled conditions (25 °C ± 2 °C, 60-70 % relative humidity and a photoperiod of 16L8D), on greenhouse-grown young potato sprouts (Blumberg & Swirski, 1977a). The temperature in the greenhouse fluctuated between 15 °C and 30 °C. The potato tubers were seeded in plastic trays (35 cm × 21 cm × 7 cm) in sea-sand which was kept continuously moist. Thionex 0.3 % (35 % E.C. of Endosulfan) was sprayed immediately at the time of sowing and every 3-4 days to prevent oviposition by the potato tuber moth, *Phthorimaea operculella* (Zell.) (Lepidoptera: Gelechiidae). Tubers with sprouts reaching the size of 10 cm were harvested, washed, the roots removed, and placed on a wet blotting paper in a plastic cage which was covered with a glass top, to retain the moisture. These tubers were then hand-infested with eggs or crawlers of the black scale. The crawlers were obtained by placing potato sprouts with ovipositing black scale females in a crawler-collection device, and collecting the hatching crawlers, which were attracted to a lighted area. When crawlers were not available, ovipositing females were placed on the potato sprouts for direct infestation.

The infested potato sprouts were kept for 3 weeks in closed plastic cages and then moved to open iron baskets. Excess honeydew was rinsed with water. Infestation by mealybugs in the rearing chambers was controlled with *Sympherobius sanctus* Tjeder (Neuroptera: Hemerobiidae). Ca. 80 % of the black scale culture was utilized for the rearing of natural enemies.

**IMPORTATION OF NATURAL ENEMIES OF THE BLACK SCALE INTO ISRAEL**

Most shipments were received from South Africa, where they were collected mostly by Dr. S. Nesser but also by Dr. S. Kamburov (table 1). Shipments were obtained also from California, Hawaii, Greece, Crete, France and Pakistan. The introduced parasitoids and predators were reared under quarantine conditions for at least one generation before being transferred to the rearing chambers (Argov & Rossler, 1988).

**REARING OF THE NATURAL ENEMIES**

We reared the natural enemies under controlled conditions (25 °C ± 2 °C, and 60-70 % RH). The laboratory host was predominantly *S. oleae*, but we used also *Saissetia coffeae* (Walker) (Homoptera: Coccidae) as an alternative host. The natural enemies were reared on scale infested potato sprouts confined in plastic cages (40 × 30 × 15 cm). Aeration holes, covered with cloth, were drilled in side-walls of the cages and the cages were covered by a glass top. The parasitoids were provided with honey-soaked paper which was affixed to the underside of the glass cover.

The introduced natural enemies were released in the orchards either as adults in small plastic cups (or vials) or as pupae in their hosts on detached potato sprouts, which were