THE ESTABLISHMENT OF *RHYZOBIUS FORESTIERI* [COL. *COCCINELLIDAE*] IN GREECE AND ITS EFFICIENCY AS AN AUXILIARY CONTROL AGENT AGAINST A HEAVY INFESTATION OF *SAISSETIA OLEAE* [HOM. *COCCIDAE*]

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Introduction releases of the exotic coccinellid predator *Rhyzobius forestieri* Mulsant were made in 22 localities throughout Greece. The releases were made on olive, citrus, fig and almond trees infested with different *Coccidae* scales. In 9 of these localities, *R. forestieri* was recovered 2-5 months later. The most important factor for the successful establishment of *R. forestieri* seems to be an abundance of scales on the trees.

To study the ability of *R. forestieri* to enhance overall predation, 3 releases were made in an olive grove heavily infested with *Saissetia oleae* Olivier on Chios island during 1982 and 1983. The experiment began in June 1982. By April 1983, the *S. oleae* infestation was clearly in the process of being controlled by the coccinellid.

A native coccinellid, *Exochomus quadripustulatus* L., contributed little during this period because of its obligatory estival diapause. The other main coccinellid, *Chilocorus bipustulatus* L., made an appreciable contribution toward achieving control during the summers of 1982 and 1983, but it was affected from July onward by increasing parasitism of its larvae. Both species are quiescent during the winter months.

The introduced species *R. forestieri* was readily established in the olive grove and multiplied quickly. One month after the initial release, *R. forestieri* larvae made up most of the coccinellid larval population in the field. Thereafter until April 1983, *R. forestieri* larvae and adults comprised the dominant coccinellid population in the olive grove. During the winter months, *R. forestieri* remains active as long as temperature exceeds 8 °C.

The important increase in *R. forestieri'*s population size between July 1982 and April 1983 coincided with the increased rate of predation on *S. oleae*. This suggests that *R. forestieri* played a key role in bringing the *S. oleae* infestation under control during this period. After April 1983, however, the *R. forestieri* population diminished rapidly and *C. bipustulatus* became the dominant coccinellid in the olive grove. It is believed that scarcity of prey was the cause of this reversal: by April 1983, the density of *S. oleae* in the olive grove had already been reduced by about 100 times.
In the Mediterranean zone, serious problems are caused by scales of the family **Coccidae** on several economically-important tree crops. The black scale *Saissetia oleae* Olivier for example is a serious pest in olive groves; *S. oleae*, *Coccus hesperidum* L. and occasionally *Coccus pseudomagnoliarum* Kuwana, often become serious pests in citrus culture; and *Ceroplastes ruscii* L. often causes serious damage to fig trees.

On all these trees, coccinellid predators are important control agents of the above scales, the most important native coccinellid predators of *Coccidae* scales in Greece being *Exochomus quadripustulatus* L. and *Chilocorus bipustulatus* L. (Argyriou & Katsoyannos, 1976). *E. quadripustulatus* is a typically univoltine species. Oviposition begins in late February. The young adults, 10 to 20 days after they emerge in June, enter an obligatory estival diapause which lasts until the end of September (Katsoyannos, 1976). *C. bipustulatus* has 2 to 3 generations per year depending on the abundance of prey.

The overall effectiveness of the native coccinellids diminishes during summer, firstly because *E. quadripustulatus* has an adult diapause and secondly because the active population of *C. bipustulatus* is disadvantaged by high parasitism on the larvae of its 2nd and 3rd generations. With the intention of enhancing the action of the native complex, the originally Australian ladybeetle *Rhyzobius forestieri* Mulsant was introduced from California into Greece in 1981.

**MATERIALS AND METHODS**

Two types of releases were carried out. The 1st type attempted to establish *R. forestieri* in as wide a network of localities as possible. The 2nd type was made in order to study the efficiency of the newly-introduced predator as a biological control agent at spots heavily infested with *S. oleae*. Except for a pilot release made at Delfi during the summer of 1981, all releases were made during Spring 1982 and Spring 1983 in the 22 localities shown in figure 1 and table 1. In each area, 30 to 40 *R. forestieri* adults were released on each of 1, 2 or more trees, according to the abundance of prey and the number of *R. forestieri* available.

Samplings were made before the following winter to check for the establishment of the predator on the release plots. The scale populations were also monitored, by visual observations and laboratory examination of samples taken at the time of the release and at the time of the establishment check. The degree of scale infestation on the trees was defined according to the following categories: very light (1-2 scales/leaf), light (3-8 scales/leaf), medium (9-27 scales/leaf) and heavy (\(\geq 28\) scales/leaf).

Favorable conditions for observing the efficiency of *R. forestieri* as a biological control agent against a heavy infestation of *S. oleae* were found in an olive grove at Cambos, Chios island, locality No. 2 of figure 1 and table 1. This olive grove was situated in a plain at sea level. It was rectangular in shape, with the long axis oriented East-West. Three sides were enclosed with 3m-high stone walls; the north side was open. The grove consisted of 97 7-to-8-year-old olive trees of the Megaritiki variety. They were planted in rows 5 metres apart and were 3 to 4 metres tall. The ground beneath the trees was ploughed almost bare many times during the year and no chemical control measures were used during the experimental period. The trees were irrigated regularly. Citrus orchards surrounded this olive grove on all sides.

*R. forestieri* adults were released 3 times in this orchard, always in the morning. The 1st release was made on 18 June 1982. 150 *R. forestieri* adults were released on 5 olive trees situated in the centre of the orchard and heavily infested with *S. oleae*. During the 2nd release, on 14 July 1982, 750 adults were released on 31 heavily-infested trees throughout the orchard. The final release took place on 7 April 1983; 900 *R. forestieri* were released on 28 trees with a medium or light *S. oleae* infestation.