State of art in artificial rearing of parasitoid insects, especially oophagous species

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Many years ago, and especially in 70's, researches were developed to try to culture entomophagous insects in artificial conditions possibly to be used in biological control strategies. At this time utilisation of natural enemies were emphasized to control agricultural pests and overcome the side effects of chemical pesticides.

One of the main difficulty limiting the possibility of utilization of these control agents was their mass production, especially for inundative releases. During many years, quite few researches have been conducted in this topic, but these past 5 years have revealed a sharp increase in works and positive results (Grenier, Greany and Cohen, 1994; Grenier, 1994). More and more teams all over the world are implicated in artificial rearing. Parasitoids of different orders (Diptera, Hymenoptera) including many families (Tachinidae, Braconidae, Ichneumonidae, Chalcididae, Pteromalidae, Tetrastichidae, Eupelmidaceae, Eulophidae, Scelionidae, Encyrtidae, Trichogrammatidae) were studied, and successfully reared in artificial media. About 40 species, including a majority of oophagous species are concerned. The best results were obtained with oophagous or pupal parasitoids which kill their host quickly and do not display a great dependence on their host physiology. On the contrary, few larval endoparasitoids (Tachinidae) have been successfully reared in vitro probably because they appeared more dependent of their host physiology.

In vitro rearing can be conducted with two main aims: Firstly, mass production and utilization of parasitoid insects in biological control strategies are the more evident aim, but secondly, artificial rearing may also constitute a tool for physiological and behavioural studies. Therefore, treatment with some chemicals should be possible (to induce insecticide resistances or behavioural learning...). Interactions between Trichogramma and some Rickettsia of the genus Wolbachia are conducted thanks to the artificial rearing system (especially symbiont transfer attempts).

A good example of the progress achieved during these past years is shown with oophagous parasitoids. Many species of Trichogramma can be cultured in vitro from egg to adult (about 17 species), and many improvements were obtained in their cultures. The rearing system includes different technologies.
- Several systems were developed for this rearing, and at present time, the best ones are constituted by a plastic membrane with small cupules (artificial host eggs) containing artificial medium set between the cover and the bottom of a plastic box.

- The stimulation of the oviposition is often desirable. One of the main difficulties is to obtain the egg laying in good condition, because a high number of Trichogramma eggs inside each cupule is necessary for a complete development. Some lepidopterous scale extracts or chemicals (hydrocarbon blend, solvents, polymers) improve significantly the oviposition of Trichogramma females.

- Two main categories of media exist: with or without insect component. The main insect component is hemolymph. The best results are obtained in artificial media containing hemolymph of Lepidoptera or holotissue extracts. Many species of Trichogramma completely develop in media containing hemolymph. But this component is sometimes difficult to obtain and can be expensive (especially in European countries). To overcome this problem, researches were conducted to define media without insect additives. The performances of media of different compositions (without insect additives) were compared to media with hemolymph and also with the factitious egg of Ephesia kuehniella. Biological parameters, as well as biochemical analyses, were considered. The development of T. dendrolimi was obtained in diet devoid of insect component.

- For a more convenient disposability of the media, it will be interesting to store them for a long time after lyophilization process. After long term storage, lyophilized media gave the same performances than fresh media of the same composition. Biological performances, such as percentages of parasitism of pupation or of emergence, were similar in the different media tested (fresh or lyophilized).

In the future, it will be necessary to improve the knowledge of parasitoid physiology and behaviour, to be able to propose an artificial rearing process for a higher number of parasitoid species. Some improvements are in progress for a large scale production of some species.

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