Effect of short-term suboptimal temperature storage to assist large-scale production of *Exorista larvarum* (L.) (Diptera: Tachinidae)

by Maurizio Benelli

Department of Biological Sciences, Fauna Park, 205b Culloden Rd, Macquarie University, Sydney, NSW 2109, Australia. E-mail: maurizio.benelli@mq.edu.au

The thesis summary given below is based on my recently defended Ph.D. thesis entitled, "Effect of short-term suboptimal temperature storage to assist large-scale production of two dipterans: *Exorista larvarum* (L.) and *Bactrocera tryoni* (Froggatt)". This project was jointly administered by Alma Mater Studiorum Università di Bologna (Italy) and Macquarie University (Sydney, Australia), with supervisors Prof. Maria Luisa Dindo (Bologna) and Prof. Phil Taylor (Sydney), and co-supervisor Dr. Fleur Ponton (Sydney).

The thesis involved research on two dipterans: *Exorista larvarum* (L.) (Tachinidae) and *Bactrocera tryoni* (Froggatt) (Tephritidae). The focus below is on the tachinid, *Exorista larvarum*.

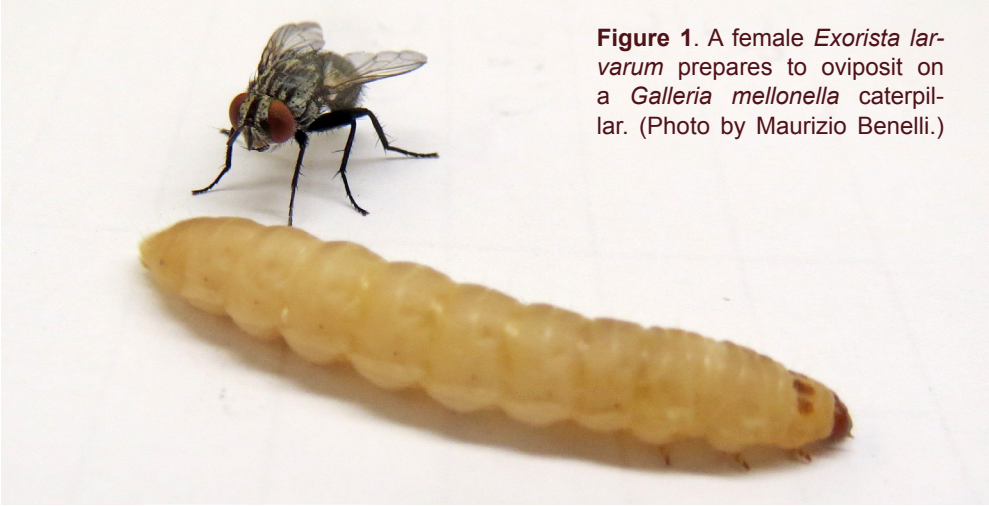

Figure 1. A female *Exorista larvarum* prepares to oviposit on a *Galleria mellonella* caterpillar. (Photo by Maurizio Benelli.)

Thesis summary

The rearing of insects has long been essential for many different purposes (research, pest management, obtainment of products such as honey, etc.) and the development of efficient rearing techniques and their refinement continue to be sought. Cold storage is a technique adopted for prolonging the developmental time of insects and thus increasing the efficiency of insect rearing. The advantages of cold storage protocols include a more flexible rearing schedule, the possibility to overcome periods of low production and, in case of beneficial insects, the synchronization of field releases with pest outbreaks in pest management programs. Native to the Palaearctic Region, *Exorista larvarum* (L.) (Diptera: Tachinidae) is a parasitoid introduced, and now established, in the United States as a biological

control agent of the gypsy moth, *Lymantria dispar* (L.). This parasitoid was chosen as a model biological control agent to develop cold storage protocols in the present Ph.D. thesis. The promising results obtained in the laboratory investigating the use of this fly for the control of several lepidopteran pest species, as well as the possibility to be easily mass reared, made *E. larvarum* a highly suitable candidate for developing a cold storage technology.

In the first study, the possibility of storing *E. larvarum* eggs at low temperatures (5°C, 10°C, 15°C and 20°C) after placement on artificial media was evaluated. Low-temperature treatments were applied in combination with the *in vitro* rearing technique, which offered the possibility to rear the parasitoid on plastic multi-well plates containing medium with no host components. This rearing method showed potential for the retrieval of eggs laid off the host that captive females oviposit on cage surfaces. Placing these eggs on artificial media is the only way to prevent their loss. By storing eggs on media at low temperatures it is possible to create a useful reserve of flies for use in colony maintenance, although some quality reductions were also observed. The best low temperature of the three tested was 15°C.

In the second study, the possibility of prolonging the pupal stage of *E. larvarum* by storing puparia at low temperatures was investigated. This study may facilitate the utilisation of tachinids in biological control programs. In fact, during mass production of tachinids in a rearing facility, fly emergence may need to be delayed before field releases with minimum impact on fly performances; for example, when the target insect pest is scarce, or it is in an unsuitable stage, or when the weather is unfavourable. The best low temperature for storing *E. larvarum* puparia was found to be 15°C.

Both studies on *E. larvarum* were performed at the Department of Agricultural and Food Sciences at the University of Bologna (Bologna, Italy). The thesis was developed in the framework of a cotutelle agreement between the University of Bologna and Macquarie University (Sydney, Australia) and explored also the effect of cold storage on the Queensland fruit fly, *Bactrocera tryoni* (Froggatt), a tephritid fly considered the most economically damaging insect pest of Australia.

The thesis will be available online in March 2019 at the following link: http://amsdottorato.unibo.it/8492/.

Figures 2–5. *Exorista larvarum* development. **2**. A female *E. larvarum* ovipositing on the factitious host *Galleria mellonella* (L.) (Lepidoptera: Pyralidae). **3**. Eggs of *E. larvarum* on host. **4**. Mature third instar larva abandoning host remains. **5**. Puparium formation. (Photos by Maurizio Benelli.)