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Influence of Temperature on the Development of *Tranosema rostrale* a Parasitoid of Endemic Spruce Budworm Populations

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Introduction

Tranosema rostrale (Brischke) (Hym.: Ichneumonidae) is an endoparasitoid associated with low density spruce budworm, *Choristoneura fumiferana* (Clemens) (Lep.: Tortricidae), populations.

This parasitoid attacks all postdiapause larval stages of the spruce budworm and can reach parasitism rates of over 90% in local populations (Cusson et al. 1998).

At oviposition *T. rostrale* injects a polydnavirus in its host which interferes with the host's immune system and prevents encapsulation and melanisation of the parasitoid's eggs (Doucet & Cusson 1996).

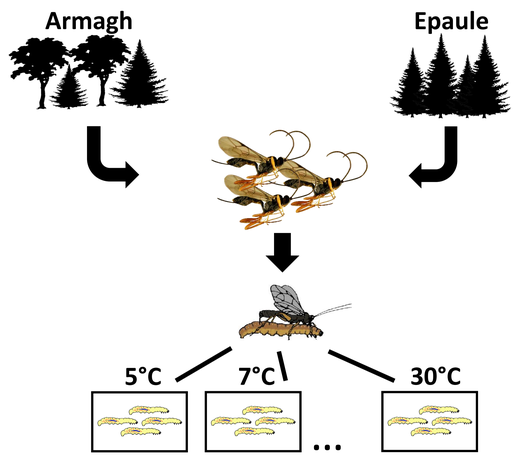
The relationship between ambient temperature and insect development and survival are critical to understand because temperature affects not only seasonal patterns of phenology and distribution, but also a species' overall population dynamics.

Objectives

(a) Determine the response of *T. rostrale* to temperature to investigate the efficacy of this parasitoid in controlling spruce budworm populations under changing climatic conditions.

(b) Provide data for the development of a simulation model to predict phenology, distribution and the influence of *T. rostrale* on spruce budworm population dynamics.

Material and Methods



See Fig. 1 for details on study sites.

See Fig. 2 for details on rearing method

Results and Discussion

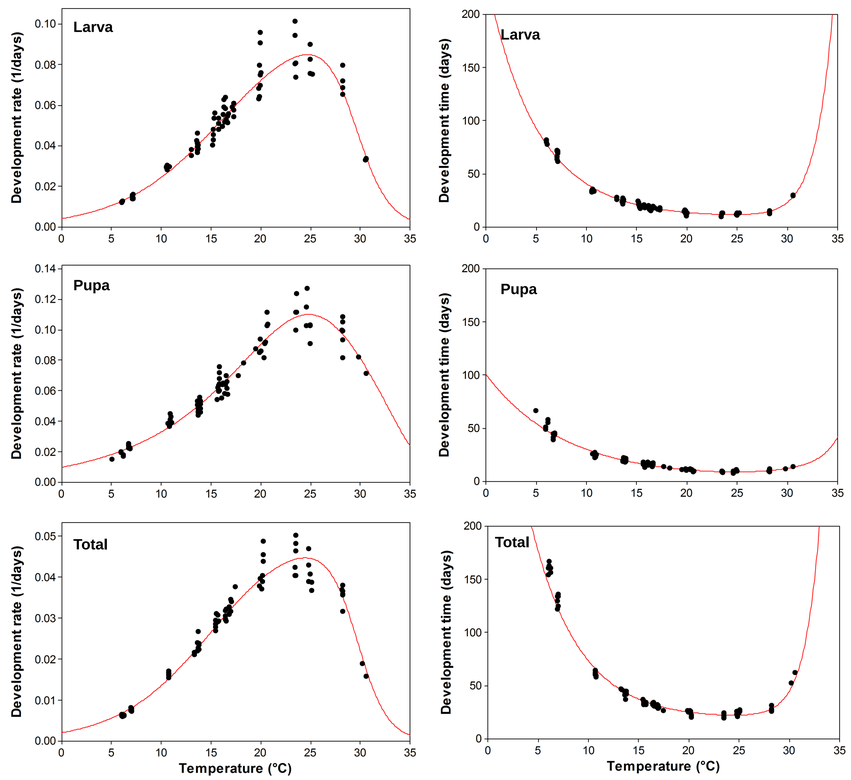


Fig. 3: Larval, pupal and total developmental rate and time of *T. rostrale* at different temperatures. Parameters of regression lines for development rate and time were calculated as described in Sharpe & DeMichele (1977) and Régnière et al. (2012).

Fig. 1: Epaule and Armagh, the two study sites from which *T. rostrale* were obtained for the study through sentinel host implantation.

Fig. 2: Plastic tubes with balsam fir foliage to rear parasitized spruce budworm larvae at different temperatures (n=295).

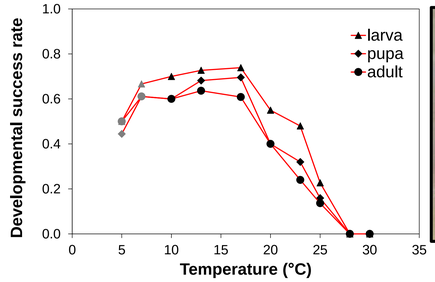


Fig. 4: Developmental success rate (parasitoid stage / total no. parasitized larva) of *T. rostrale* larvae, pupae and adults at different temperatures. Grey markers indicate values obtained through transfer treatments.

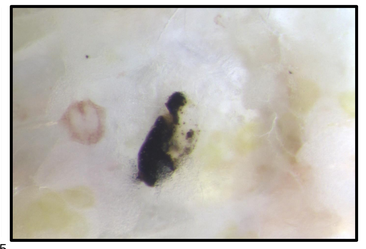


Fig. 5: Melanised *T. rostrale* egg in a dissected spruce budworm larva reared at 30°C for 5 days.

- Developmental rate and time reached an optimum at about 25°C, above which development slows down again.
- Success of *T. rostrale* to develop in spruce budworm larvae rapidly decreased with increasing temperatures above 17°C and no development occurred at constant temperatures of 27 and 30°C (Fig. 4).
- Dissections of parasitized spruce budworm larvae after rearing for five days at 30°C showed that *T. rostrale* eggs are getting melanised (Fig. 5), explaining the decreasing rate of developmental success with increasing temperature.
- Further experiments will be conducted to explore reasons for the detrimental effect of high temperature on developmental success of *T. rostrale*.
- Development rates and -success will be used to develop a simulation model to predict phenology, distribution and probable impact of *T. rostrale* on endemic spruce budworm populations.

Conclusions

- *Tranosema rostrale* is poorly adapted to high temperatures when developing in spruce budworm larvae.
- Temperature may be an important factor to explain dynamics of endemic spruce budworm populations.
- A temperature-based simulation model can help to predict the parasitoid's impact as mortality factor under changing climatic conditions.

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