Determining the Development Rates of Grape Berry Moth Stages

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Abstract

The grape berry moth Lobesia botrana, a severe pest of vineyards and stone fruits, completes its life cycle within two and occasionally three generations in Northern Europe, while in the Mediterranean climates of the Near East four generations are common. Due to the cryptic nature of the developing larvae that feed inside the berries, just the short time window from egg oviposition to egg hatch is applicable for control, as emerging larvae are fast to dwell into the berry where they are sheltered from insecticides. To estimate this crucial window within each generation the rates of the development stages have to be determined. Development is most obvious a non-linear function of temperature. Hence, a set of climate chamber experiments were established to monitor the development of the moth stages at constant temperatures in the range of 10°C to 28°C. The data provide information about the longevity of adult males and females, egg production and the population dynamics of the stages L1, L2-L4 and pupae, as these vary with temperature. The results were used a) to estimate the parameters of the related temperature response functions of each stage and b) to provide the parameters for an age structured Leslie model. As a result the complete life cycle of the moth is summarised to a constant parameter vector of the model, which is applicable for a large range of temperature patterns. Applying the Leslie model with its estimates, taken from the results of the climate chamber experiments, to long-term field data demonstrates both the importance and need of constant temperature experiments as well as the possibilities of upscaling laboratory results to field situations.

Keywords: Grape berry moth, modelling, parameter estimation, pest control

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