USING RESPIRATION RATES OF SINGLE EGGS TO DETERMINE GYPSY MOTH PRE-DIAPAUSE DEVELOPMENTAL RATES

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ABSTRACT

Gypsy moth (*Lymantria dispar* L.) egg phenology has been described as being comprised of three phases: pre-diapause morphological development, diapause, and post-diapause morphological development. Despite a large amount of published information on the temperature-time requirements of egg hatch there exists no robust model of the process(es) involved. This may be largely due to an inability to distinguish the phases of development (Rubstov 1938[1], Lyons and Lysyk 1988[2]). This inability has necessitated that the observed (dependent) variable in egg phenology studies be the temperature and duration of the final incubation period leading to egg hatch, despite the fact that treatments may have been applied to eggs in a diapause, pre-diapause, or post-diapause phase. Respiration rate has previously been unusable as a distinguishing characteristic due to the requirement of using hundreds of eggs in each measurement. This has prevented accurate estimation of temperature-time requirements for each phase, and obscured variability within the population.

This paper proposes a three phase model to describe gypsy moth egg phenology, and presents a novel technique for determining the temperature requirements of the pre-diapause phase, and preliminary estimates of population variability in those requirements.

Respiration rates of individual gypsy moth eggs were determined under temperature conditions ranging from 4°C to 38°C using an infrared gas analyzer. Among individuals of equal physiological age, temperature had a significant effect on respiration rate. Among individuals reared at constant temperatures, respiration rate was observed to increase with time and then decline rapidly to a steady rate of approximately 50% of each maximum. This rapid decline was interpreted as the completion of pre-diapause development.

A non-linear development rate curve was fit to the inverse of the median development time for each temperature. Population variability in pre-diapause temperature requirements was described by a three parameter Weibull function fit to the normalized development times.

This technique has the important ability to distinguish developmental phases on the basis of an accepted physiological parameter. Using appropriately designed experiments, this technique can be used to determine the uniqueness or commonality of the phases, the relationships between developmental phases, and the developmental rates of each unique phase.

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[1] Rev. Appl. Entomol. A.27:313-314.

[2] Proceedings. Lymantriidae: A comparison of features of new and old world tussock moths. USDA Gen. Tech. Rep. NE-123.