PROGENY PRODUCTION AND ADULT LONGEVITY OF THE MEALYBUG PARASITIDS \textit{ANAGYRUS PSEUDOCOCCI}, \textit{LEPTOMASTIX DACTYLOPII}, AND \textit{LEPTOMASTIDEA ABNORMIS} [HYM. : ENCYRTIDAE] IN RELATION TO TEMPERATURE

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Progeny production increased and adult longevity decreased with rising temperature within the range 18°C to 30°C for the 3 mealybug parasitoids \textit{Anagyrus pseudococci} (Girault), \textit{Leptomastix dactylopii} Howard and \textit{Leptomastidea abnormis} (Girault). The Weibull distribution gave a good fit to survival curves for the 3 parasitoids and statistical comparison of Weibull $b$ and $c$ parameters at different temperatures allowed changes in the scale and shape of the curves to be detected. In general, $\varnothing$ lived longer than $\delta$ for all 3 species, except at high temperature. Female \textit{L. abnormis} attained their maximum progeny production at 24°C and maintained this level up to 34°C. They lived longer than the other 2 parasitoid species at 30°C and showed a type I survival curve throughout the range of temperatures examined. \textit{A. pseudococci} and \textit{L. dactylopii} both required high temperatures (30°C) to attain their maximal progeny production, but were short-lived at this temperature. At 30°C the survival curves of both $\delta$ and $\varnothing$ \textit{A. pseudococci} tended towards type II, with a larger proportion of the population dying within the first few days. \textit{L. dactylopii} lived longest at 26°C, with $\varnothing$ showing a type I survival curve at all temperatures and $\delta$ survival curves changing from type I to type II at 30°C. The implications of these findings for the population dynamics of the different parasitoids are briefly discussed.

KEY-WORDS: \textit{Anagyrus pseudococci}, \textit{Leptomastix dactylopii}, \textit{Leptomastidea abnormis}, temperature, adult longevity, progeny production.
temperature for many species of insects. Generally, the oviposition rate reaches a maximum at relatively high temperatures near to the upper limit for egg laying, falling sharply above this maximum, but more gradually below it (Bursell, 1964). Work on the effects of different constant temperatures on progeny production by *A. pseudococci*, showed that high temperatures stimulate egg laying by this parasitoid (Avidov et al., 1967; Niyazov, 1968). No data are available on oviposition by the other 2 parasitoid species at different constant temperatures.

Adult longevity of *A. pseudococci* has been examined at 3 constant temperatures and it was found that the life-span was reduced at high temperature (Avidov et al., 1967). No data exist on this relationship for either *L. dactylopii* or *L. abnormis*.

A method of representing longevity data using the Weibull distribution was put forward by Pinder et al. (1978) and used to describe survival curves of false wireworms by Allsopp (1981). It enables statistical comparison of the shape and scale of different survival curves, providing valuable information which is lost if longevity is summarized as a mean with standard deviation or as a single LT50 value, as is commonly done.

The aim of this study was to investigate the effect of various constant temperatures on progeny production and adult longevity of *A. pseudococci, L. abnormis* and *L. dactylopii*, with particular reference to the impact on parasitoid population dynamics.

**MATERIALS AND METHODS**

The parasitoids were from cultures maintained on their natural host *P. citri*, feeding on sprouted potato tubers (*Solanum tuberosum* L.) at 26 °C and 45-60 % R.H. The experimental procedure was the same for all 3 species, unless otherwise stated, and the same for each temperature regime.

**PROGENY PRODUCTION**

Fifteen female parasitoids were removed from cultures containing adults aged between 1-7 days, and 5 were placed, under CO2 induced anaesthesia, in each of 3 ventilated, plastic boxes (173 mm × 115 mm × 65 mm) streaked with honey solution (approx 50:50 honey: water) at either end. These were then left at the experimental temperature for approximately 17 h, giving a period starved of hosts in which to recover from the anaesthetic and acclimatize to the temperature. *A. pseudococci* and *L. dactylopii* were provided with predominantly 3rd instar and adult *P. citri* and *L. abnormis* with predominantly 2nd and 3rd instars. Three sprouted potatoes, heavily infested with mealybug of the appropriate stage (at least 200/potato) were then introduced into the boxes and left undisturbed for 5 h. After this period of time the ♀ parasitoids were removed under CO2, and the boxes incubated at 26 ± 0.5 °C. Emergence of offspring was monitored twice daily.

The temperatures used were 18 ± 0.5 °C, 20 ± 0.5 °C, 22 ± 0.5 °C (*L. dactylopii* only), 24 ± 0.5 °C (*A. pseudococci* and *L. abnormis* only), 26 ± 0.5 °C, 30 ± 0.5 °C and 34 ± 1 °C. All (except the last) were achieved using constant temperature rooms with relative humidity between 45 % and 60 % and lighting was provided throughout the experimental period on an 18/6 h light/dark cycle by a combination of 30 W, 40 W and 65-80 W fluorescent tubes. The 34 °C regime was achieved using an illuminated, cooled, Gallenkamp compenstat incubator (1 300 mm × 500 mm × 500 mm) with constant lighting provided by 4 × 8 W fluorescent lamps.

**LONGEVITY**

Mummified mealybugs were removed from cultures of the parasitoids and isolated individually in 50 mm × 25 mm glass vials, streaked with honey solution (50:50 honey: