FRUIT FLIES
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Laboratory studies on isolated pairs of *Ceratitis capitata* (Wied.):
Results obtained during the last three years in Spain

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**Summary**

The most important results on the reproductive activity of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.), obtained from the last experimental studies with isolated pairs, at a series of constant temperatures between 19°C and 31°C, in Spain are presented.

Both distributions, log-normal and 4th degree polynomial, have allowed us to determine the experimental conditions upon which production of eggs, larvae, pupae and adults reaches its optimal value. In general, these conditions were 22 ± 1°C, 67 ± 1% RH and 12:12 hrs light-dark regime. After fitting several functions to the experimental data, the power-exponential model was chosen as the best one to explain the biological phenomena.

Weights of pupae originated from old females were significantly higher than those estimated from the younger ones. Development times of eggs, larvae, pupae and periods of the biological cycle were obtained, as well as two critical bands of temperature. With these data it was possible to estimate the minimum number of generations per year in two Spanish zones where this species is a permanent pest.

1. **INTRODUCTION**

Studies regarding basic scientific knowledge of insects, the planning and its subsequent applications to pest control must include, as a priority aim, management of data with a high degree of reliability. For this reason, from 1981 to 1984, we have carried out precise experiments and mathematical calculi using isolated couples of *Ceratitis capitata* (Wied.). With these studies it was possible to estimate parameters of the reproductive activity, as well as development times of life stages and periods of this species, at fixed environmental conditions.

On the other hand, parental age effects on the pupae quality were analyzed at a temperature of 26 ± 1°C, 60% RH and 12:12 hrs light-dark regime (1,900 lux). Experimental studies on the possibility of sexing the Medfly's pupae according to their weight were also carried out at the conditions above mentioned.

Although detailed laboratory and mathematical methodology will be published in the next future, we want to report here the most remarkable results obtained.
Fig. 1 FITTING MODEL CURVES TO EXPERIMENTAL DATA

2. MATERIAL AND EXPERIMENTAL CONDITIONS

Isolated pairs of the Mediterranean fruit fly were removed from a lab-strain established in the Instituto Español de Entomología 20 years ago and introduced in the oviposition cages provided with adult food and water. The fixed conditions of temperature and relative humidity were as follows: 19 ± 1°C, 78 ± 3% RH; 22 ± 1°C, 67 ± 4% RH; 25 ± 1°C, 57 ± 4% RH; 28 ± 1°C, 67 ± 2% RH; 31 ± 1°C, 73 ± 3% RH; a photoperiodic regime of L 12:12 was fixed.

The composition of the larval diet was as follows: (in % by weight) Water 50; wheat bran 27,9; sugar 14; Hansenula anomala 7; Nipasol 0,1; Nipagin 0,1 and conc. HCl 0,9.
3. RESULTS

3.1. Optimal experimental conditions
We have applied log-normal and polynomial distributions to the observed data in order to know the conditions upon which mean fecundity, fertility and production of pupae and adults reach their maximum values. Generally, at 22 ± 1°C and 67 ± 4% RH, the reproductive activity of Ceratitis was the highest: The flies laid a daily average of about 40 eggs/female and a total number of about 1,800 eggs/female were estimated. The percentages of egg hatching, pupation and adult emergence, along the female life, were 71.67 and 66%, respectively. The oviposition period was 45 days and females' longevity was 50 days.

3.2. Curve fitting
We have fitted three different functions to the experimental data (Fig. 1): One of them is composed by three linear functions which approached closely the data and allowed us to estimate the "critical days" of the biological phenomena. The fitting polynomial model was also a good one from a theoretical point of view, but it was not useful to explain the biological processes because there were too many fluctuations involved in the fitting curves, specially when a high polynomial order was adapted.

The power-exponential model was an advantageous fitting technique, because it involves curves that increase quickly at the beginning, until they reached a maximum value, and then decrease slowly with an asymptotic branch. For these reasons we propose this model as the best one to explain the variation of the aforementioned phenomena (fecundity, fertility, etc.) in relation to the reproductive activity of this species (Fig. 2).

3.3. Parental age effects
With regard to the parental age effects on the pupal quality, we conclude that: For all conditions used in our experimental studies, weights of pupae originated from old females were significantly higher than the ones estimated from the younger ones, except at 31°C. This result is irrespective of the pupal age and the larval density, except when the quantity of protein (Hansenula anomala) in the larval diet was reduced from 7% to 2% by weight.

3.4. Temperature thresholds
Finally, development times of eggs, larvae, pupae and different insect periods of the biological cycle of Ceratitis from the laboratory data were estimated using hyperbolas of the BLUNCK-BODENHEIMER type. These functions allowed us to determine two critical bands of temperature in order to know the lowest and the highest temperature thresholds as well as estimating the minimum number of insect generations per year in two Spanish zones where this species is a permanent pest. This number was greater than 5 in several regions near the coast.

The band of temperature under which the insect development is slow ranges from 11.98 to 16.35°C and the other one in which the insect develops problematically ranges from 36.9 to 39.34°C. Therefore, the lowest threshold of temperature is 11.98°C and the highest one is 39.34°C.