

DIAPAUSE IN FIELD POPULATIONS OF CODLING MOTH *CYDIA POMONELLA* (L.) (LEPIDOPTERA: TORTRICIDAE) UNDER SOUTHERN CHILE CONDITIONS

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ABSTRACT

Populations of codling moth in southern Chile, were principally univoltine. Almost 100% of the spring generation entered into diapause, even though summation of degree days and photoperiod could permit the development of a second generation. All larvae tested showed an oligopause type of diapause, which could be terminated by an exposure to 17 h photoperiod and 18°C.

Key words: *Cydia pomonella*, diapause.

RESUMEN

La polilla de la manzana, se comporta principalmente como monovoltina. Casi un 100% de la generación de primavera entra en diapausa, aunque la sumatoria de los días grados y el fotoperíodo permitiría que una gran parte de esta desarrollara una segunda generación. Todas las larvas estudiadas presentaron oligopausa, la cual puede ser terminada exponiéndolas a un fotoperíodo de 17 h y a 18°C.

Palabras clave: *Cydia pomonella*, diapausa

INTRODUCTION

Diapause has contributed greatly to the evolutionary success of numerous species of insects, allowing insect populations to survive at different latitudes. Studies throughout the world have shown that diapause of fifth instar larvae of the codling moth, may be obligate (independent of environmental conditions) or facultative (Dickson 1949; Russ 1966; Wildbolz & Riggenbach 1969; Sieber & Benz 1980 and Ashby & Singh 1990). Diapause of some populations in the codling moth can be terminated by long photoperiod coupled with high temperature (Russ 1966; Ashby & Singh 1990); however in most cases, diapause is terminated by a period of low temperature, followed by long or short days and high temperature (Russ 1966; Wildbolz & Riggenbach 1969; Sieber & Benz 1980 and Ashby & Singh 1990). According

to Muller (1970), the first type of diapause is an oligopause and the second is an eudiapause, because it can be broken only by a period of chilling.

The goal of this study, was to measure the incidence of diapause off codling moth larvae infesting apple orchards in southern Chile and elucidate the type of diapause.

MATERIAL AND METHODS

Experiments were carried out in two apple orchards located near Valdivia and at the Universidad Austral de Chile (39°48' S; 73°14' W). Fifth instar larvae were trapped in strips of corrugated cardboards 30 cm width, which were wound around the trunks of 40 apple trees. Larvae found inside cardboards were removed twice weekly and placed inside a piece of quadrangular cardboards (3 x 3 cm) in separated clothing bags (15 x 20 cm), to provide the mature larvae with a cocooning site. Bags with larvae from each collection date were exposed to ambient environmental condition, but covered with a roof to protect from rain. The bag movement produced by wind was reduced attaching both extremes to the framework.

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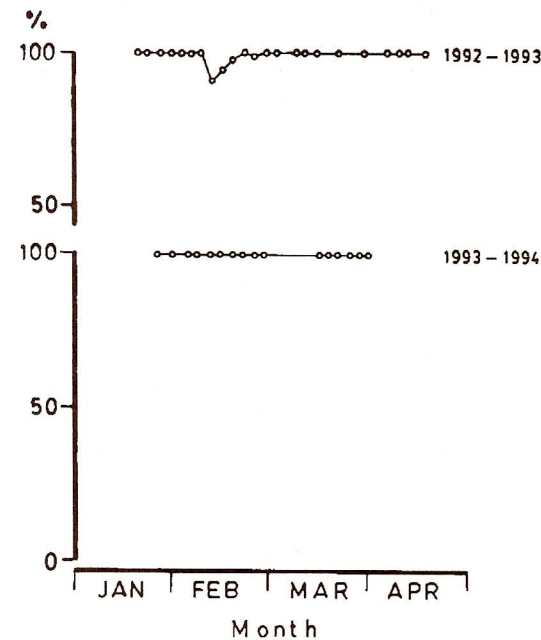
Larvae were maintained in these conditions from the first date of trapping, until three weeks after no larvae were trapped inside the corrugated cardboard bands. Insects were then transferred to the laboratory and number of pupae or pupa remains and diapause larvae of each date was recorded. Diapausing larvae were transferred singly with a fine camel hair brush to Petri dishes (55 cm), placed inside environmental chambers and reared individually at 18°C, long photoperiod 17:7 (LD) and rooked cotton to provide humidity. The light source in the environmental chambers was fluorescent tubes 40 W.

Larvae pupating under conditions indicated above within 45 days were considered as oligopause diapausing insects.

RESULTS

Diapause on codling moth larvae population.

Under local field conditions prevailing in Valdivia a high rate of diapause was recorded in larvae obtained from apple trees during two seasons (Figure 1). In the 1992-1993 season, 99,67% of the larvae entered diapause and during the next season 100% of the larvae reached such conditions.



1

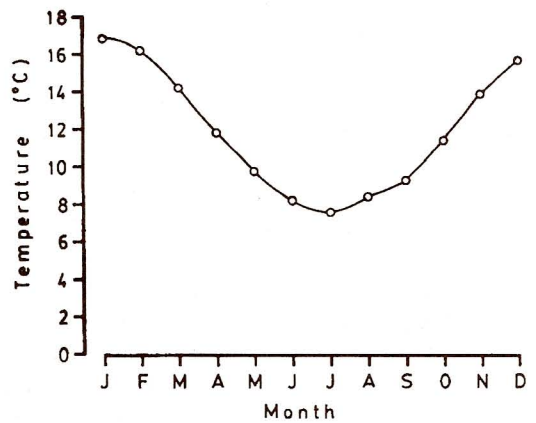
Diapause termination on long day photoperiod and temperature.

All diapausing larvae obtained from the field at the end of the season (April) and transferred to 17 hours of photoperiod with a temperature of 18°C, broke diapause and pupated at the end of 45 days.

DISCUSSION

The results showed that a high proportion of the population entered diapause in summer, even though quantitative degree days in the area (Ibarra 1992) during the period of activity of the codling moth it is higher than the necessary, so that most the first generation might emerge as adults and produce a second generation able to reach the diapause larval stage (Shel'Deshova 1967; Riedl 1983).

The high rate of diapause induction, in spite of the photoperiod and temperature being favourable for development of a second generation suggest that prediapause factors such as mild temperature in the area might act as modifiers of the temperature and photoperiodic response (Beck 1980; Tauber *et al.*, 1984).



2

Figures 1-2: 1. Percentage of diapause larvae in *Cydia pomonella* populations under field conditions, during summer early and autumn of two successive years. 2. 1960-1969 average monthly mean temperature, Valdivia-Chile. (Huber, A. 1970).

Our results showed that the diapause of the *C. pomonella* population studied, belongs to the oligopause type according to Muller (1970), in that it can be terminated by the reversal of the diapause inducing factor(s). The fact that the type of diapause was an oligopause is uncommon, since eudiapause is the predominant form in this species (Russ, 1966; Sieber & Benz 1980; Ashby & Singh 1990) and is terminated in most cases by an exposure to a chilling period, followed by post chilling conditions of higher temperature and long days. However, there have been reports of oligopause in some codling moth populations in Europe (Wildbolz & Riggenbach, 1969; Suber & Benz, 1980). That the type of diapause differs from the predominant type is not a surprise, since species that occupy a wide geographic range such as the codling moth, will experience different biotic and abiotic factors and must evolve local populations adapted to rather specific conditions (Chippendale, 1982). For that reason, geographical strains of insects often differ considerably in their diapause characteristics (Lees, 1980).

The fact that the type of diapause found was an oligopause and not an eudiapause, might be related to the weather characteristics of the area which has a mild winter with temperatures, seldom under 0°C (six days per year in average) (Huber 1970), and with the lowest average monthly temperature being 7,6°C (July) (Figure 2), so the chilling period might be insufficient to break an eudiapause.

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