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**BIONOMICS OF *DACTYLOPIUS COCCUS* COSTA
(HEMIPTERA: COCCOIDEA) IN A GREENHOUSE IN SICILY.**

ABSTRACT

BIONOMICS OF *DACTYLOPIUS COCCUS* COSTA (HEMIPTERA: COCCOIDEA) IN A GREENHOUSE IN SICILY.

A study on the biology of *Dactylopius coccus* Costa was undertaken to evaluate the possibility of mass-rearing it commercially in Sicily. The colonies of *D. coccus* were maintained on 2-3 years old cladophylls of *Opuntia ficus indica*, rooted in plant pots, in a greenhouse near the Faculty of Agricultural Sciences, the University of Catania. Almost daily observations were made between April 1995 and August 1996. Three reproductive cycles of the scale insect were observed; the duration of each instar, the length of each life cycle, female fecundity and the effects of the biotic factors have been studied.

Key words: mass rearing, *Opuntia*, biology, Dactylopiidae, fecundity, environmental conditions, Canary Islands, Mexico, Peru, Bolivia, Chile, Sardinia, dye, *Exochomus flavipes*, mortality, phototaxis, temperature, humidity.

INTRODUCTION

Among the scale insects used by man commercially, *Dactylopius coccus* Costa (Hemiptera: Coccoidea: Dactylopiidae) is probably the species which has been of the greatest interest. The Incas reared it and used the acidic dye, which they extracted from the scale-insect bodies, as goods of exchange (Donkin, 1977). Today, with the coming of synthetic dyes, the production and use of these natural dyes has suffered a considerable reduction. For this reason, *D. coccus* is now only bred commercially in Central America (Mexico), South America (Peru, Bolivia, Chile) and the Canary Islands (Flores-Flores & Tekelenburg, 1995), even though it may be present in almost all continents.

During the last century, several unsuccessful attempts to breed *D. coccus* in Italy were made by introducing specimens of various strains into areas of Sardinia (Blanchard, 1883) and Sicily (Inzenga, 1861) which have a particularly mild climate. More recently, as part of a European Union Demonstrative Project for alternative production, attempts to mass rear *D. coccus* under controlled conditions have been started in Sicily. Some reports on this research have already been published (Russo & Mazzeo, 1996; Mazzeo *et al.*, 1998) and they are summarized in the present paper.

MATERIALS AND METHODS

These observations were made between April 1995 and August 1996 in a glasshouse in the Institute of Agricultural Entomology, University of Catania, using specimens kindly sent from the mass breeding cultures in the Canary Islands. The cultures of *D. coccus* were maintained on 2-3 year old cladophylls of *Opuntia ficus indica*, rooted in plant pots. According to Flores-Flores & Tekelenburg (1995), the inoculation should be made by placing 20-25 ovipositing females in a tulle bag fixed to the cladophylls with cactus thorns. This technique, widely employed in South America, allows the crawlers to disperse over the host but prevents the feeding activity of the ladybird *Exochomus flavipes* ab. *nigripennis* Erichson, an effective predator of *D. coccus* that has been found in the original colonies. When the crawlers have settled on the cladophylls and have started to produce the characteristic white wax filaments, the surrounding area of the cladophyll was marked using a felt pen. These individuals of *D. coccus* were monitored almost daily. Moults were recorded by counting and removing the exuviae. The wax filaments were partially removed each day to facilitate observation. Males were not disturbed after they had begun to form their cocoons.

The behaviour, duration and survival of each life stage was recorded. Whenever possible, fecundity was studied by dissecting single mated females under a stereomicroscope.

RESULTS

Climatic factors have a marked influence on the biology of *D. coccus*. The 1st-instar nymphs are strongly negatively phototactic and so sunlight causes them to settle in areas on the cladophylls protected from direct solar radiation. Temperature and humidity also affect the length of each instar and its mortality (Figs 1 & 2). There were two generations a year and the length of each instar is shown in Fig. 1. The following minimum and maximum values were found: N1 - from about 20 days (Spring-Summer generation) to 38 days (Winter-Spring generation); N2 - from about 12 (Spring-Summer generations, 1995) to 25 days (Spring-Summer, 1996); adult female - from 21 (Winter-Spring generation) to 36 days (Spring-Summer, 1995). The length of the male nymphal instars was almost identical to those of the female and the average length of the pupal and prepupal stage was 22 days. The adult male survived for 2 to 6 days.

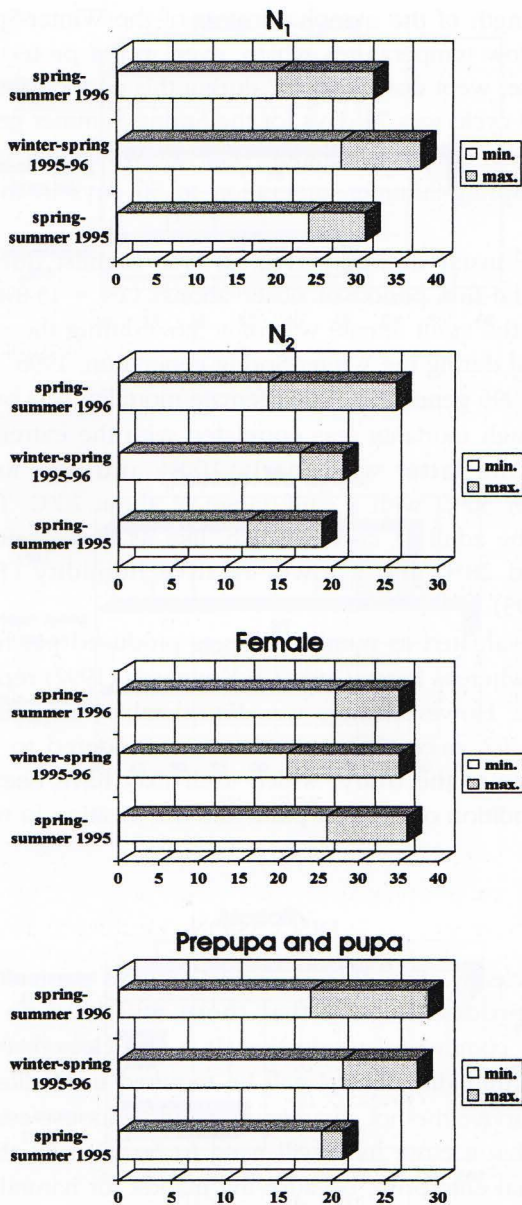


Fig. 1. Length of the N₁, N₂, adult female and prepupa + pupal stages of *Dactylopius coccus* Costa in a greenhouse in Sicily.

The greater length of the nymphal instars of the Winter-Spring generation was due to the low temperatures which, even in the protected environment of the greenhouse, went down to 12°C during this period. The average length of the female life cycle was 74 days for the Spring-Summer generation and 85 days for the Winter-Spring generation (Fig. 2), while that of the male was from 45 in the Spring-Summer generation to 56 days in the Winter-Spring generation.

First- and 2nd-instar mortality (Fig. 2) was highest during the Spring-Summer, 1995 (the first period of observations) (1st = 15.8%; 2nd = 16.7%). The mortality of the adult female was only 3.6% during the same period and was practically nil during the Winter-Spring generation, 1996. However, in the Spring-Summer 1996 generation, adult female mortality was over 90% (Fig. 2). This extremely high mortality was correlated with the extreme temperatures and humidity: the latter was nearly 100% and was associated with temperatures over 50°C, with a daily range of about 20°C. These conditions were lethal for the adult *D. coccus* which, like its host, prefers temperatures between 24 and 28°C and a lower relative humidity (Flores-Flores & Tekelenburg, 1995).

The fertility, evaluated as number of eggs produced per female, averaged only about 251, whereas Perez Guerra & Kosztarab (1992) reported a mean of about 430/female. However, there was considerable variability in the Sicilian specimens (min. 62, max 459) and this was considered to be due to such factors as the size of the ovary, which itself may have been related to the physiological condition of the host plant and the position in which the female had settled.

DISCUSSION

These results clearly show that *D. coccus* requires particular conditions for growth and reproduction and that these will have to be taken into consideration for commercial production. It is also clear that some degree of temperature and humidity control will be required in Mediterranean areas if the insect is to survive the hot summers under greenhouse conditions.

This implies that a close look will need to be taken at the economics of such a commercial enterprise, because the market for natural dyes in Europe is small due to the production of cheaper synthetic products. As the natural dyes can also contain human pathogenic microorganisms, the synthetic dyes are also more hygienic.

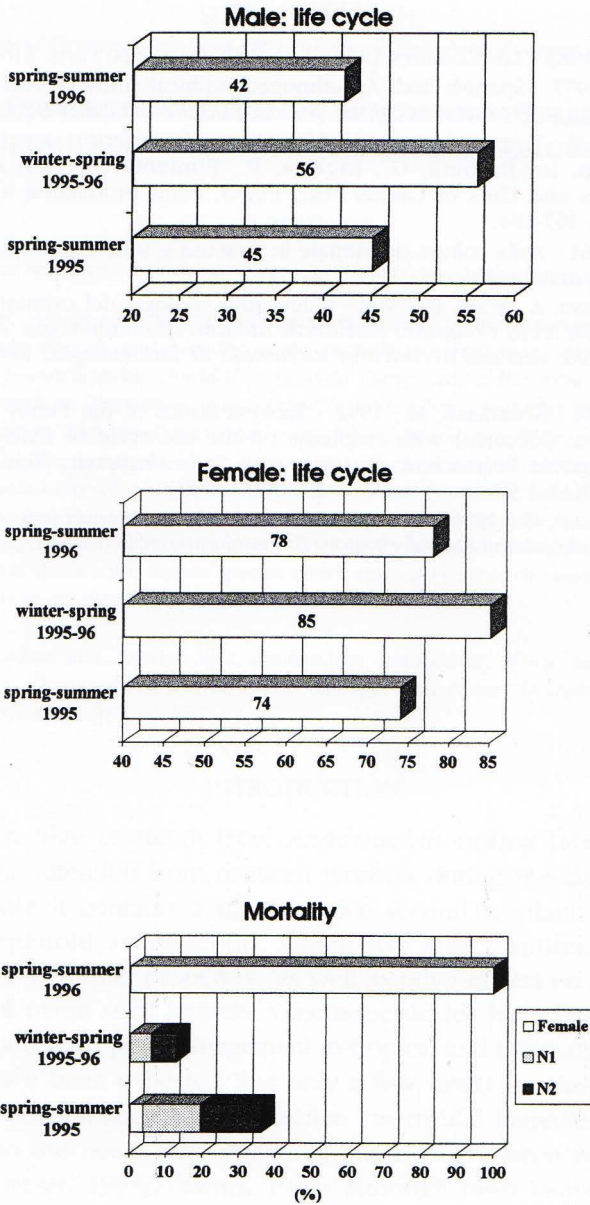


Fig. 2. Length of the female and male life cycle and mortality of *Dactylopius coccus* Costa in a greenhouse in Sicily.

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