Natural Enemies of Cochineal (*Dactylopius coccus* Costa): Importance in Mexico

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ABSTRACT

At the present time, the culture of carmine cochineal (*Dactylopius coccus*) is redeveloping in Mexico and the world. However, several natural enemies reduce very significantly the populations of this insect on its *Opuntia* hosts, especially in Mexico where there is a higher impact. Therfore, it is necessary to develop some controls over the enemies of cochineal. This paper presents information about the natural enemies of cochineals, with emphasis on Mexico, as a first step to support further controls.

INTRODUCTION

The pre-Hispanic cultures that developed in Mexico had an extraordinary knowledge of their natural resources, which were used to obtain the daily sustenance that allowed them to develop and reach the civilizations that today surprise foreigners and even Mexicans (Portillo and Vigueras 1998a). The main elements used by these cultures were plants, which were cataloged by their applications and took part of their identity from the application (Figure 1). Some plants had a divine level, for example, Teonochtli (the divine prickly pear) (Bravo 1978) and peyotl (God from the Huichol trilogy).

During the colonial period, some plants and their products were taken to Europe (Portillo 1995). Some products were in high demand, including the red pigment obtained from the insect called grana or cochinilla (cochineal) (*Dactylopius coccus* Costa). This insect was so economically important that it was the third highest income for New Spain after gold and silver exportations (Brana 1964). Mexico was the first producer of cochineal during the colonial period (Dahlgren 1963), but, today, the greatest quantity of cochineal is obtained from regions of Peru, Canary Islands, and Chile, where cochineal has almost no natural enemies. In Mexico, cochineal has the largest number of natural enemies.

At the present time, there is a resurgence in demand for carmine cochineal due, in part, to reports that synthetic dyes produce alergic reactions, and because there is a worldwide desire to use products free of artificial additives (Portillo 1992). Because of the great importance that cochineal is again taking on, there is renewed interest in Mexico in producing this insect. However, the presence of natural enemies in some places makes it necessary to recognize the importance of this organism in cochineal cultivation (Portillo and Vigueras 1998b).

The goal of this paper is to consolidate information about the main natural enemies of cochineal in Mexico in order to subsequently develop controls of them and, thus, support the establishment of cochineal production.

METHODOLOGY

It was necessary to collect specimens of natural enemies in cochineal cultivations and wild populations of cochineal in several Mexican states. The support from the old literature (written during the last two centuries) was of great value because the information contained in such papers gave some routes for research, as well as a vocabulary necessary for coccidoculture. All reports in this bibliography were enriched with data from the contemporary literature, field observations, and communications from coccidocultors from Mexico and Peru.

RESULTS AND DISCUSSION

According to Alzate and Ramirez (1777) and Rossignon (1884), some natural enemies were found in cochineal cultures and in wild populations of cochineal (Mann 1969, Gilreath and Smith 1987) (Figure 2). Of all the depredators, insects seem to be the most important group (Table 1). This could be because the insects are the natural enemies with more diversity and stay within the cochineal colonies, behavior not observed with other kinds of depredators (e.g., lizards, rats, etc.). The main insect depredators of cochineals (*Dactylopius* spp.) reported in the literature have been found in Mexico. All of the host plants of the cochineal colonies were identified as species of *Opuntia* and *Nopalea* (*Opuntia amyclaea* Tenore*, O. atropes* Bravo*, O. cantabrigiensis* Lynch*, O. brasilienis* (Willd.) Haworth*, O. ficus-indica* (L.) Mill.*, O. fuliginosa* Griffiths*, O. jaliscana* Bravo*, O. leucotricha* De Candolle*, O. lindheimeri* Engelmann*, O. microdasys* (Lehmann) Pfeiffer*, O. megacantha* Salm-Dyck*, O. pilifera* Weber*, O. robusta* Wendland*, O. sarca* Griff. ex Scheinv. *O. schikendantzii* Weber*, O. stricta* Haworth*, O. streptacantha* Lem., *O. tomentosa* Salm-Dyck). It is necessary to identify the species of *Dactylopius* (except *D. coccus*) and their natural enemies.

Table 1. Natural Enemies of *Dactylopius* spp Obtained from Reports in Literature and by Communications from Coccidocultors

Natural Enemies	Source
Hens, woodpecker bird, rats, insectivorous birds and entomophagous insects	Alzate and Ramírez 1777
Larvae and worms	Rossignon 1884
Insects from Lepidoptera, Coleoptera, Diptera and Neuroptera	Mann 1969
Insects from Lepidoptera, Coleoptera, Diptera and Neuroptera. Birds, rodents and reptiles	Piña 1977
Insects from Coleoptera	Baranyovits 1979
Insects from Hymenoptera, Diptera, Lepidoptera, Coleoptera and Neuroptera	Zimmermann *et al.* 1979
Pyralid moth (Lepidoptera)	Eisner and Nowicki 1980
Ants and larvae, insectivorous birds, some rats and reptiles	Herrera 1983
Fly *Allograpta* sp. (Diptera)	Marin 1986
Insects from Neuroptera, Coleoptera, Lepidoptera and Diptera	Gilreath and Smith 1987
Insects from Lepidoptera, Coleoptera and Diptera	Eisner *et al.* 1994
Fly *Allograpta* sp. (Diptera)	Flores y Tekelenburg 1995
Insects from Lepidoptera, Diptera, Neuroptera and	De Haro and Claps 1998

Coleoptera	
"Arrocitos" (larvae of Lepidoptera)	Coccidocultor from Jalisco, Mexico
"Gusano tambor", "gusano telero", ″gusano aguja", "catarinitas", "armadillos" (larvae of Diptera, Lepidoptera, Neuroptera and Coleoptera)	Coccidocultors from Oaxaca, Mexico
Larvae of Neuroptera	Coccidocultor from Ica, Peru

Table 2 lists the entomophagous observed attacking cochineal cultures (*D. coccus*) in Mexico.

Table 2. Predators of *Dactylopius coccus* Collected in Several States of Mexico

Order, Family, and Genus Scientific Name	**Common Name**
Lepidoptera: Pyralidae *Laetilia coccidivora*	gusano telero (weaver worm) arrocito (little rice)
Diptera: Syrphidae not identified	Gusano tambor (drum worm)
Neuroptera: Hemerobidae *Sympherobius* sp.	gusano aguja (needle worm)
Coleoptera: Coccinellidae *Hyperaspis* sp. *Chilocorus* sp.	catarinita (lady bug)
Other larvae not identified	Unkown

The presence of insects that depredate cochineal is an important factor to be considered in coccidoculture because the cochineal colonies often are reduced significantly. In Jalisco, Mexico, some host plants (prickly pears) in cochineal cultures have showed populations of cochineal eliminated 100% by fly larvae (Diptera: Syrphidae) (Figure 3).

The insects that depredate cochineal in Jalisco state are the same as those in Oaxaca state and other regions of Mexico. In other parts of the world, several authors have reported depredators of cochineals (Table 1).

The presence of natural enemies of cochineal in Mexico is very significant because some depredators could become a serious threat, producing eight to ten generations per year, especially in regions with a warm climate, where cochineal culture must be intensive; otherwise, the production could be lost, as happened in the colonial period (Alzate and Ramirez 1777).

Recently, in Peru, the larvae of a hemerobid (*Sympherobius* spp.) has begun attacking the cochineal plantations, eliminating up to 40% of immature cochineals (Portillo and Vigueras 1998b). This insect is present in Mexico and is named gusano aguja (needle worm). The biological control of natural enemies over cochineal is very strong because these enemies are common and frequently hold cochineal populations in check (Miller 1976). These observations are primordial for

coccidoculture, because the natural enemies are established in Mexico. Therefore, the control of entomophagous is a necessity for the coccidocultors in Mexico, and must be an objective if the production of cochineal is really wanted.

Rossignon (1884) reported that the main method for control of cochineal depredators was by hand (gusanear). This method is a good solution for small cultivations (Figure 4), but not for large operations. Therefore, it is necessary to develop better controls, to use alternative bioinsecticides, traps with pheromones, and other techniques that could give solutions without affecting the natural origin of the insect.

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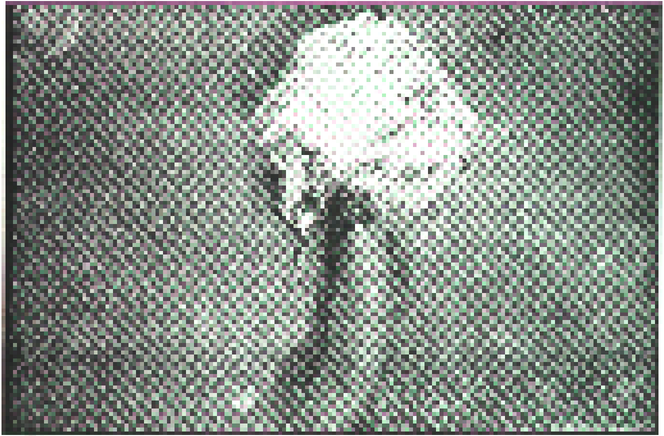

Figure 2. Larva of *Laetilia coccidivora* attacking *Dactylopius* sp. Photo by Esteban Rodriguez

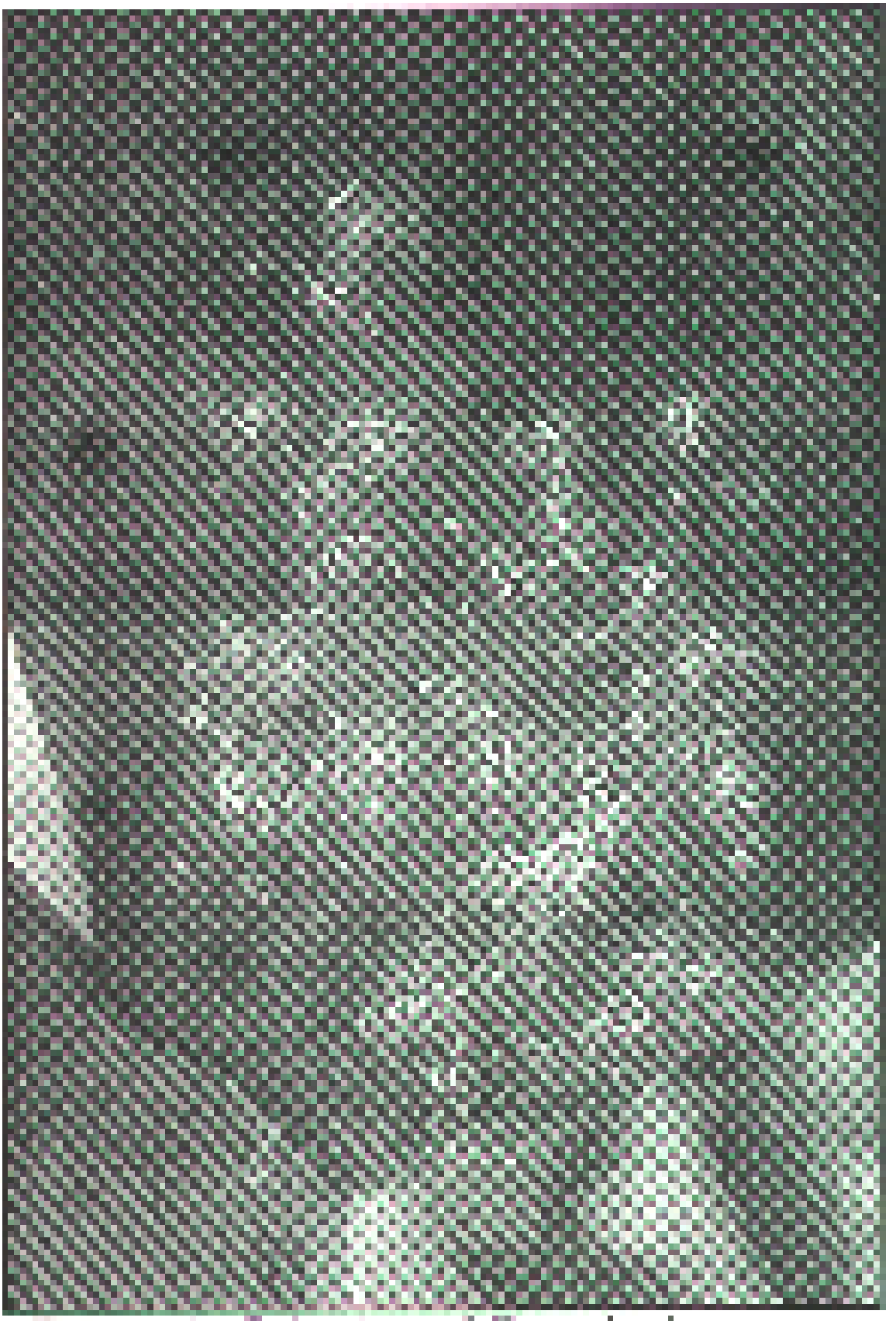

Figure 3. Colonies of *Dactylopius coccus* eliminated 100% by larvae of syrphids. Photo by Liberato Portillo.

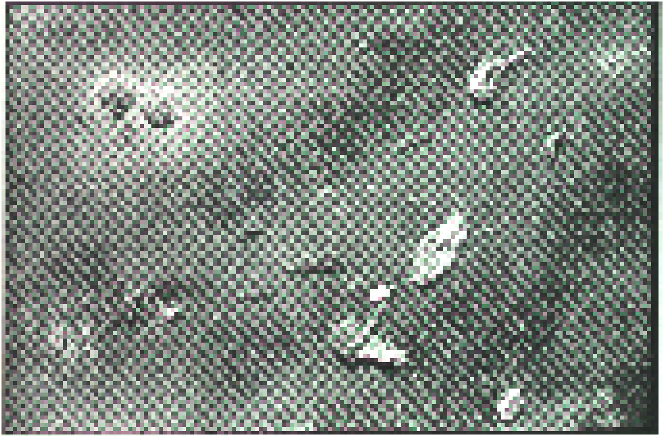

Figure 4. Larvae of *Laetilia coccidivora* (gusano telero) just after the control by hand (gusanear). Photo by Hilda Arreola.