

GROWING PRICKLY PEAR FOR COCHINEAL (GRANA) DYE PRODUCTION

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Introduction

In international conferences on prickly pear utilization, emphasis has been placed on uses of cactus for fruit, nopalitos, forage, medicine, industrial products, and as a source of water. The importance of pigment production by insect cochineal, or grana (Dactylopius coccus) for carminic acid extraction is only now beginning to be seriously considered. The red/purple dye obtained from these insects was originally developed by the Aztecs and has been extensively used in coloring foods, textiles, and cosmetics.

Before America was discovered, the production of purple and scarlet dyes was done principally by Phoenicians. Later, dyes of these colors were extracted by the Ottomans from the sea snails genera Purpura, and Murex, and insects such as Marracordes polynicus and Kermes vermilio. In the Colonial Era, dyes extracted from cochineal reached their maximum importance about a half century ago. The decline in use of cochineal based dyes occurred when synthetic aniline dyes became available early in this century. While anilines are easy to use in the textile industry, there are drawbacks to use of these dyes because they cause allergies and skin cancer. In contrast, natural dyes do not affect one's health but they are difficult to obtain and use in extensive applications.

History of Grana Production

In colonial times, principally in the Oaxaca State of Mexico, there was a notable increase in production. This production occurred in small villages in an artesanal way. To protect the increasing commercial production, severe laws were passed to avoid adulterations. The maximum production of 716 tons occurred in 1774. Grana production then decreased because of factors such as: worker dissatisfaction due to heavy workloads with low pay, internal and external wars, production in other countries, pests and diseases on prickly pear and cochineal, the ease of aniline production and its subsequent widespread utilization.

Grana Actual Production

Total world production of grana is about 270 tones per year, Peru being the main producer with 211 tons per year. The remaining grana production occurs in the Canary Islands, Algeria and Mexico. Today grana is used in:

- * Food industry in beverages, cookies, ice cream, meat and others.
- * Cosmetic industry in lipsticks, eye shadow, face powder and make-up.
- * Industry textile, threads dyes, clothing and craft products.

- * Pharmaceutical industries, histological and bacteriological dyes.
- * Picture and painting industries.

Different Grana Types

- a) **Finest grana:** This type of grana consists of a white, waxy powder with none of the cotton type fibers of the wild grana. This type of grana harms the plants very little.
- b) **Low quality grana:** This grana type has white, cotton like fibers that make it difficult to separate the grana. The low quality grana is quite harmful to cactus, often causing chlorosis and even death. This wild, low quality grana is more adapted to adverse factors of wind, cold, and rain than the high quality grana.

Commercial products of the finest grana include:

- c) **Black grana:** This grana has the greatest value and is obtained from granas which are used to make new 'nests', or reproduction. It has the greatest value.
- d) **Silver grana:** This grana is obtained from harvest of grana immediately after the first female brings the eggs.
- e) **Cochineal extract:** This is a concentrate obtained after the alcohol has been eliminated from an aqueous-alcoholic extract of the cochineal. Typically, this extract is more than 1.8% carminic acid.
- f) **Aluminic calcic laquer:** This is an aqueous aluminum hydroxide extract of the cochineal and contains more the 50% carminic acid.
- g) **Carminic acid:** 100% pure, and difficult to obtain.

Grana Climatic Requirements

The principal climatic conditions for grana productions are:

- a) **Absence of frost and hard winds,** because the insect delays its biological cycle in cold temperatures and can die.
- b) **Temperature of 25° to 35° C.**
- c) **High relative humidity.**
- d) **Shade in all cactus leaves (cladodes).**
- e) **Photoperiod over twelve hours.**

Principal Methods of Exploitation of Grana

- a) In the field (only in absence of frost). This is the easiest method and has the lowest cost, but it also has the lowest production.
- b) In tunnels (with one layer of shade cloth and one layer of polyethylene). This method is advantageous because higher quantities of leaves are in the lower shady layers.
- c) In canopy or 'tapexcos'. Plants or leaves are tied onto frames of wood.

In all cases, control of pests and diseases on host plants are very important.

Process of Growing Grana

Growing grana requires professional care. The main factors in growing grana are:

- a) The condition of host plant: Succulence, turgescence, spinelessness and age (one year old is preferred).
- b) Different varieties of host plants are used in different regions. For example, prickly pear San Gabriel, Nopal de Castilla, San Cristobal and Nopales de Seda are used. In Peru, Nopal de Castilla is used as the host plant.
- c) Disease free succulent cladodes.
- d) Use only finest female grana insects for inoculation i.e. those with good size, high reproduction rate (large eggs and high viability) free of white powder, without depredation and free of wild grana.
- e) Preparation of grana nests. To ensure the cladodes are infected within cochineal, a small piece of cloth containing adult females is attached to the cladodes. The mesh of the cloth is just large enough to allow the larvae to penetrate the cloth to infect the cladodes, but not large enough to allow the adult female laying eggs to penetrate the cloth.
- f) The proper number of female cochineal by grana nest: 100-150 females.
- g) Fixation of grana nests: The grana nests are attached to the cladodes with wooden "tooth-pick" like pins. Metal pins cause rotting and other problems.
- h) Infestation: The cladodes must be washed before the grana nests are attached.
- i) Periodical change of grana nests to avoid insect production. In 15 days, each female produces 250 to 450 eggs, enough to cover all the cladodes.
- j) Care during infestation: Place and change nests continuously to shaded zones.

- k) Insect's biological cycle: Its knowledge is very important because it determines the best way of infestation and harvest time.
- l) Harvest: The harvest occurs 3 to 4 months after infestation, depending on whether the harvest is for black grana or silver grana. The grana is harvested by brushing the grana off the cladodes into a small pan.
- m) Killing and drying: The grana are killed either in boiling water for 2 to 3 minutes, by placing them directly in the sun or by putting them in ovens at temperatures of 60-70° C. Once killed, the grana are dried in the shade.

Economic Analysis for Grana Production

The price of the grana ranges from about \$30 - \$100/kg. depending on the grana quality.