

Analysis of the investment costs of the in vitro production of orchids of the Huasteca Potosina

Análisis de los costos de inversión de la producción in vitro de orquídeas de la Huasteca Potosina

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Abstract

The Huasteca Potosina is an area of great importance for biodiversity in Mexico, because it has a large number of plant species such as the Orchidaceae family. However, the distribution of some of the orchids has diminished notably due to the alteration and destruction of their habitat, extraction and illegal trade, as well as their difficult reproduction. An alternative to prevent the extinction of species and decrease the time of regeneration and loss of orchid biodiversity is in vitro micropropagation, which allows to increase the multiplication rate in a time and space reduced. Therefore, the objective of this work was to analyze the investment costs of two orchids produced in vitro (*Encyclia parviflora* and *Encyclia marie*), and market analysis. The unit cost of each seedling was determined and a high market potential for orchids produced in vitro was found.

Orchids, Micropropagation, Costs, Market Analysis

Resumen

La Huasteca Potosina es una zona de gran importancia para la biodiversidad en el país, ya que alberga una alta riqueza de especies vegetales como la familia Orchidaceae. Sin embargo, la distribución de algunas de estas orquídeas ha disminuido notablemente debido a la alteración y destrucción de su hábitat, extracción y comercio ilegal, así como a su difícil reproducción. Una alternativa para evitar la extinción de las especies y disminuir el tiempo de regeneración y la pérdida de la biodiversidad de orquídeas es la micropropagación *in vitro*, la cual permite elevar la tasa de multiplicación en un tiempo y espacio reducido. Por ello, el objetivo de este trabajo fue realizar el análisis de los costos de inversión de dos orquídeas producidas *in vitro* (*Encyclia parviflora* y *Encyclia marie*), y el análisis del mercado. Se determinó el costo unitario de cada plántula y se encontró un alto potencial del mercado para las orquídeas producidas *in vitro*.

Orquídeas, Micropropagación, Costos, Análisis de Mercado

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Introduction

The orchids have been appreciated since antiquity as ornamental plants by different factors such as its rarity, color, perfume and the different forms that come to take in an adult stage. Most orchid species are native to mountainous regions with tropical and temperate climates (Navarro et al., 2001). They are considered as the most evolved plants of the plant kingdom, and as the most abundant in the world.

Orchids are probably the most extensive family of plants, with more than 25,000 species identified so far by scientists. The orchids, represent a group of plants of considerable economic importance, especially in horticulture and floristry, but also in the pharmaceutical industry and the essences. Currently, orchids are included in the appendices of maximum protection of environmental protection organizations, for their care both inside their habitats and outside of them (Rivera-Dueñas, 2002).

In some developing countries orchids are their main economic line. Mexico has about 1,400 species of orchids growing in almost all types of vegetation, however, most are below 2,000 meters above sea level, in the mountains of the center and south of the country, in various types of tropical and temperate forests (INECOL, 2017).

Orchids of Mexico

Orchids are one of the groups of plants most admired and appreciated by different civilizations for many centuries, mainly due to the beauty of their flowers. They are herbaceous plants, perennial, monocotyledonous, most genera are hermaphroditic (with the exception of the genera *Catasetum* and *Cycnoches*), zygomorphs (only a plane of symmetry), trimeras and with a central structure that supports the male reproductive organs (anthers) and feminine (pistil) fused in a structure called Column. In Mexico, the extraction for local and international sale is considered one of the biggest conservation problems of the orchids, because their ecosystems have been seriously disturbed (Brewster, 2002).

That is why ex situ conservation represents a way of protecting species with great ornamental potential (Solano et al., 2007) and in order to be subsequently used in a sustainable way by producers under legal marketing schemes.

Orchids represent a commercial value that in the future can become an economically important activity, as well as being a way of conservation and rescue of endangered species. The intention of the National System of Phytogenetic Resources for Food and Agriculture (SINAREFI) is to create opportunities for use that are complementary to other conventional productive activities, such as agriculture, livestock or forestry.

In particular, the Huasteca Potosina concentrates a great biological richness with species of flora of biological and ornamental importance as the orchids that are unique in the region. Among some of the orchids that have been reported for this region, are *Laelia anceps*, *Encyclia parviflora*, *Encyclia mariae* among other species.

Problems of orchid reproduction

Some species of orchids are considered protected or in danger of extinction under NOM-059-SEMARNAT-2010 as a consequence, directly or indirectly, of two types of human activities: i) Alteration of habitat or destruction resulting from the change in use from the earth; ii) The extraction of wild plants for trade (Hágsater et al., 2005).

In addition, the cultivation of orchids is a field that is just beginning, and the lack of studies with these species has further limited their development. Some species have reproductive problems or show little response to conventional methods of vegetative propagation. A biotechnological alternative is the cultivation of vegetable tissues (CTV). The CTV, is a set of techniques that allows in an efficient way the reproduction of a cell, organs or tissues in synthetic culture media under aseptic conditions and photo periods. By means of this technique, pathogen-free plants of excellent quality can be obtained by reducing the times and spaces of the evolutionary process (Rivero, 2007).

The idea of spreading orchids, arises with the need to recover native species in danger of extinction since the undue incursion of man into natural environments has generated imbalance in both orchids and other native species, for this reason, in vitro propagation allows to give possible solutions and help to avoid the massive loss of biological material.

When using the in vitro culture technique, virus-free plants are obtained, which can then be propagated massively, since genetically identical individuals are obtained from the mother plant.

Currently, in the UAMZH Environmental Sciences laboratory, thirteen wild orchids have been micropropagated from the Ciénaga de Tamasopo Natural Wetland SLP, of which, three species are under some category of the NOM-059SEMARNAT-2010, five other species of Orchids are of economic and / or ornamental interest, and three species are in the beginning stage of in vitro culture. The most interesting thing about a job like this is that it is carried out in conjunction with the social and productive sectors. Therefore, the objective of this research was to carry out a study of the investment costs and the analysis of possible market of the vitroorchis that contemplates the phases preacclimatación and acclimatization of the orchids in vitro.

Description of the method

The methodology used in the present investigation was of a qualitative nature with a data collection method in clusters given that the study was focused on a particular population. For the development of the project, and the construction of the market study, three stages were carried out.

Stage 1. Data collection

The first stage consisted of making a diagnosis about the current costs of the orchids, for this, information was collected through the bibliographic review of the ornamental activity in Mexico. In addition, surveys were applied to producers of plants in the Huasteca Potosina, and users of these services. The questions were structured with multiple choice and easy application.

Stage 2. Cost analysis

The second stage of the methodology consisted in obtaining the cost of producing orchids generated through in vitro culture in the Environmental Sciences Laboratory of the Biochemistry Department of this Academic Unit with the aim of obtaining a unit price to be able in a future carry out the transfer of technology to producers. Part of the second stage consisted of knowing the materials and raw materials that are needed in the stages of micropropagation, as well as making a data collection of the times each of the stages takes. For this, all the factors that are involved in the production process of the orchids were taken into account, such as indirect production costs and raw materials.

Stage 3. Simulation of unit costs

The third stage consisted of obtaining the unit cost of the orchids produced in vitro with the purpose of establishing an average price of each of the plants that would be for sale to the producers of the Huasteca Potosina. The surveys were applied both to people who have acquired an orchid or ornamental plant and to producers of different nurseries of the Huasteca Potosina. In total 100 surveys were applied, with which some interpretations were built in this thesis.

Results

Orchids are the most attractive ornamental flowers for the rarity of their flowers, therefore, they reach prices ranging from 75 pesos to 180 pesos according to data from the Mexican Orchid Association) as a full plant, or \$ 150.00 up to \$ 500.00 as cut flower according to data obtained in the tours in the greenhouses that were necessary to have a broader view of the subject to be investigated.

Given its economic and ornamental importance, orchids are the most vulnerable plant species and are subject to illegal looting by sellers, who sell them on the streets at a cost of \$ 10.00 (Monreal-Vargas, 2014). This situation, added to the difficulty that these species present for their propagation, has favored the orchids tend to have variations in their natural populations, and that the economic demand of them is increasing.

Therefore, it is important to offer alternative methods of propagation of these species such as in vitro cultivation of plant tissues or micropropagation. However, despite this technique has been applied to various plant species, it has not been possible to link this technique with the producers of ornamental plants, because each plant species is different and requires different nutritional and production conditions. Based on this, in this research, two plant species (*Encyclia parviflora*, *Encyclia mariae*) propagated in vitro were selected under similar conditions. Once the plant species were selected, the analysis of the investment costs necessary for the micropropagation of both orchids was carried out (Table 1). For this, we worked in a multidisciplinary way with laboratory-level operators to identify in detail all the costs of the inputs used for the in vitro cultivation of orchids..

Production stage	Cost of the stage
Costs of the asepsis process (Disinfection)	\$ 266.40
Germination	\$ 7, 690.70
Establishment of the crop	\$ 11,173.76
Multiplication of the tissue	\$ 12, 182.46
Pre-acclimatization	\$ 4, 854.45
Acclimatization	\$ 1, 347.00
INVESTMENT TOTAL	\$ 26,341.01

Table 1 Analysis of the costs of in vitro production of orchids

In Table 1, the investment cost of each one of the stages of the micropropagation of the orchids is presented, taking into account the necessary inputs such as chemical reagents, culture media, growth hormones, natural substrates, culture vessels, etc., of each stage. The results of Table 1 show that the stage of the in vitro culture that requires greater investment is the multiplication of the tissue, given that it is in this stage where the plants require higher nutritional conditions, as well as a greater number of reseeded in vitro.

Once the investment cost was calculated, the unit cost of the orchids was calculated. The results are presented in Table 2.

	<i>Encyclia parviflora</i>	<i>Mary encyclia</i>
Number of bottles of species produced per cycle	100	85
Number of seedlings per culture flask	18	20
Unit cost of culture flask (\$ Mexican pesos)	263.41	309.89
Unit cost per seedling (\$ Mexican pesos)	14.63	15.50

Table 2 Vitroorchid unit costs

Table 2 summarizes the unit costs of the vitro-chromosomes under study. According to the investment costs, the seedlings would have a very similar unit cost, which compared to the current cost of potted plants in the market, is 10 times lower. The cultivation and collection around the world is of great economic importance. In the cut flower industry, orchids are highly prized for their variety, shapes, colors and sizes, which has stimulated them to deepen their study, are potentially commercial as plants and cut flowers, to such a degree that their value and marketing has increased remarkably; so it is, that there are countries like Thailand and Singapore, in which the exploitation of orchid flowers represented between 7-8 million dollars (Ammirato, 1990). The in vitro propagation of orchids offers the following advantages:

- It is a clonal propagation system, that is, it maintains all the genotypic characteristics of the initial material selected. Because of this it is an ideal system for the massive multiplication of plants or varieties with outstanding characteristics.
- Because it is carried out in a laboratory under controlled environments, it is a system completely independent of external conditions, so it is not affected by the seasons, droughts, frosts, high temperatures or other environmental factors.
- The number of plants that can be obtained through micropropagation is by its nature practically unlimited. The only limit that can have is the capacity of the laboratory in which the process is carried out.

- The plants are obtained free of bacteria, fungi and phytopathogenic nematodes, and with more specific techniques can be released even from viruses and viroids. For this reason, the seedlings produced by the micropropagation system have a higher quality compared to those obtained by traditional methods.

Subsequently, to analyze the possible market of the vitro-produced produced, a market analysis was carried out. To do this, several nurseries were analyzed at the regional level, as well as the main flower shops of the Huasteca Potosina. The results are presented in Table 3.

	Existing orchid market	Orchid market segmentation	New market for in vitro orchids
customers	Established nurseries	Cutting Florists	Innovative floriculturists
Customer needs	performance	1. Cost 2. Existing need	Immediate solution and good position in the market
performance	Good	Good	Major
Competition	Existing in the region	Existing in the region	Does not exist
Risks	Competition	1. Competition 2. Niche strategy	High acceptance of the product

Table 3 Analysis of the market of orchids produced in vitro

The results of Table 3 show that there is a potential market for the sale of orchids produced in vitro, given that at the regional level there are no producers of this type. To date they only reproduce orchids vegetatively with very low yields. Therefore, given that micropropagation has gone from being a tool for research to a productive process with a very broad economic potential, it is necessary to take into account other considerations, in addition to the purely scientific ones when it is desired to apply for commercial purposes. Many times it is not enough to have a very productive micropropagation system, but other factors that may affect the time of making decisions, which will be mentioned later, must be taken into account.

- Form of production
- Production center
- The cost of production
- Profit margin that will be obtained per produced plant
- The potential market

- Type of species that is going to be produced.

The problem of the sale is not exclusive to the Huasteca Potosina, it is rarely considered that the development of this activity occurs where the coffee plantation shares spaces with threatened ecosystems of tropical forest and mountain mesophilic forest, which can contain more than 10 % of the biodiversity of species of plants and animals known to Mexico, and that in the case of the Huasteca Potosina as in the rest of the country, little by little they are losing ground and are replaced by paddocks, monocultures and urban areas (Manson et al., 2008).

Conclusions

According to the results obtained from the market study of orchids from in vitro culture, it was determined that the demand justifies in vitro production and the possible commercialization of orchids. Unit costs were estimated per bottle and per plantlets, which is considered profitable to start production. It was found that the most expensive stage of the crop is that it includes the establishment and multiplication in vitro, since it is in these stages where more inputs are required. In addition, it was found that society in general has an appreciation for orchids, and they would be interested in acquiring this type of products in the nurseries of the Huasteca Potosina.

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