AP AGRO PRODUCTIVIDAD

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Laelia anceps Lindl. (Orchidaceae) adaptation on phorophytes within an anthropized landscape

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ABSTRACT

Objective: To determine the best phorophyte species for the adaptation of the *Laelia anceps* Lindl orchid. (Orchidaceae) in an anthropized landscape.

Design/Methodology/Approach: A completely randomized experimental design with four treatments (phorophytes) was used: *Swietenia macrophylla* King., *Fraxinus* sp., *Persea schiedeana* Nees., and *Tecoma stans*. (L.) Juss. ex Kunth), with five repetitions per phorophyte and with three *L. anceps* orchid plants in each phorophyte. The following variables were measured: day to emergence, root length and thickness, and survival at 28 weeks after tying them in phorophytes.

Results: Root emergence of *L. anceps* took place in less time in *S. macrophylla* and in *Fraxinus* sp. at 52 and 54 days, respectively. The longest root length (19.11 cm) and number of roots (32.45) were observed in *S. macrophylla*; however, the root thickness was greater in *Fraxinus* sp. (0.28 cm). After 28 weeks of establishing the *L. anceps* plants, 100% survival was obtained in the phorophytes *S. macrophylla* and *Fraxinus* sp., 77% in *P. schiedeana*, and 33% in *T. stans*.

Study Limitations/Implications: The amount of light received by *L. anceps* in each phorophyte was not measured.

Findings/Conclusions: The best phorophytes observed for the establishment of *L. anceps* were *S. macrophylla* and *Fraxinus* sp., with the best development and strength of the roots and 100% survival at 28 weeks.

Keywords: native trees, epiphyte, host, native orchid, orchid survival.

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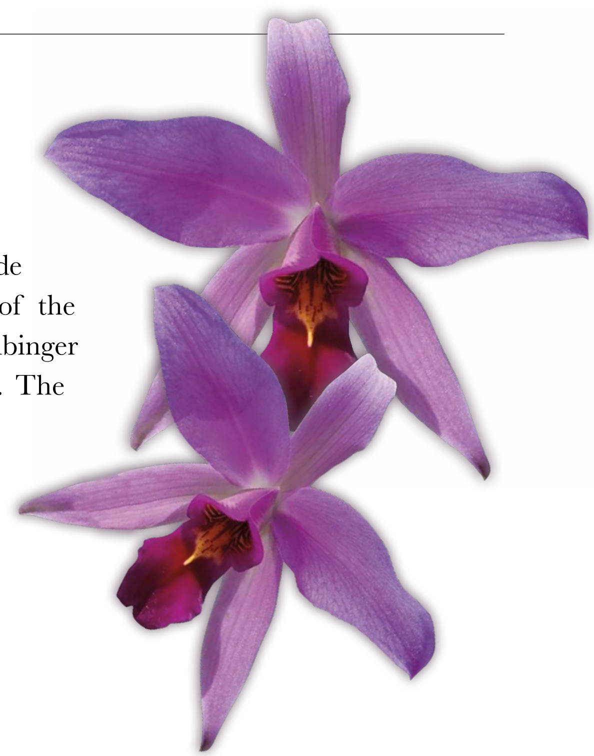
INTRODUCTION

Orchids have been part of the national culture in Mexico since pre-Hispanic times. Within this family, the species *Laelia anceps* Lindl. has stood out for its beauty, wide use and distribution, which makes it one of the most appreciated ornamental species (Halbinger and Soto, 1997; Baltazar-Bernal *et al.*, 2020). The flowering season coincides with the Day of the Dead festivities and it is widely used in altars (Halbinger and Soto, 1997), so it is considered a sacred orchid (Hágsater *et al.*, 2015). In Veracruz it is known as *monjitas* or *calaveritas*.



Like most orchids, *L. anceps* has been severely affected by illegal harvesting and commercialization, but also by habitat loss and fragmentation (Mondragón *et al.*, 2015; Solano-Gómez *et al.*, 2007). Specifically, landscape fragmentation impedes the movement of orchid propagules by decreasing the phorophytes or trees that host them, in addition to relative humidity (Montibeller-Silva *et al.*, 2020). Therefore, the conservation of forests that harbor the greatest diversity of phorophytes with orchid communities is very important (Morales-Linares *et al.*, 2019). Because of the above, and given that orchids are very frequent common goods in urban landscapes, it is vital to understand the biophysical factors that influence their establishment and the conservation of these public spaces (Batty *et al.*, 2002). Among these biotic factors are the variations in microclimate necessary for the development of orchids and the organisms with which the orchids and their phorophytes interact, such as fungi, lichens and pollinators, which are strongly altered by anthropogenic activities (Besi *et al.*, 2019). In this sense, the reintroduction of orchids and other plants in ecosystem restoration programs is very important if a habitat similar to that found before the landscape was disturbed is to be recreated (Phillips *et al.*, 2020). It is also vital to include local communities or villages in forest restoration and conservation programs, particularly the phorophytes and orchids that inhabit them (Trimanto, 2020), in order for the programs to be more successful. These conservation efforts are important because landscapes with high plant cover are inhabited by a greater number of epiphytic species (Leighton *et al.*, 2016).

In the case of the orchidaceous flora in Veracruz, it constitutes 90% of the species with epiphytic growth (CONABIO, 2011), and the fundamental partners for this type of orchids are the phorophytes (Menchaca and Rendon, 2016). Phorophytes are mostly arboreal species that offer anchorage, support and provide characteristics (bark type, foliage density, crown shape) that help orchid development (Benzing, 2008; Granados *et al.*, 2003).

The best way to evaluate the quality of a phorophyte is the survival of an orchid established in it, as has been done in some studies. For example, regarding the *in situ* survival of the genus *Laelia*, Luyando-Moreno *et al.* (2011) evaluated the *in situ* survival of *L. autumnalis* in a pine-oak forest, specifically identifying *Arbutus xalapensis* as a good phorophyte for the epiphytic orchid *L. autumnalis*. On the other hand, Morales (2019) evaluated the survival of *in vitro* cultivated seedlings of *L. anceps* established in a tropical oak forest, for which he recommended placing the seedlings 5-6 m above the ground, in the oak trees. Apparently, no orchid survival studies have been carried out. Thus, taking into consideration the above, this study aimed to determine the best phorophyte species for the adaptation of *L. anceps* in an anthropized landscape, using native trees.

MATERIALS AND METHODS

Study area

The study was conducted in the gardens of Colegio de Postgraduados Campus Córdoba (CPCC), located in Amatlán de los Reyes, Veracruz at 18° 51' 21" N, 96° 51' 35" W, and an altitude of 627 masl. The climate is semi-warm and humid, with abundant rainfall in summer; the average annual temperature range is between 20 and 24 °C, and annual rainfall is 2150 mm (INAFED, 2021). The vegetation of the study area consists of tree species of mesophilic forest and lowland tropical rainforest, with native species such as *Annona* sp. (pawpaw), *Persea schiedeana* Nees. (Creole avocado), *Tecoma stans*. (L.) Juss. ex Kunth) (yellow elder) and *Fraxinus* sp. (ash), and introduced species such as *Azadiractha indica* A. Juss. (neem), *Mangifera indica* (mango), and *Citrus* × *lemon* (lemon) (Baltazar-Bernal *et al*., 2020), which are some natural or potential phorophytes of different types of epiphytic plants, such as orchids.

Plant material

L. anceps is a medium-sized orchid native to Mexico, producing 80 cm long flower stalks with an inflorescence composed of two to five flowers (Halbinger and Soto, 1997; Figure 1). It flowers from mid-October to early December. Because of its beauty, the variety of its colors and the size of its flowers, it is an orchid that is traded in traditional markets in the Campus Córdoba region (Baltazar-Bernal *et al*., 2020).

The study period was from November 2020 to June 2021. Four adult *L. anceps* plants showing damage from water stress, fungi, and sunburn were collected from areas adjacent to the campus. The plants were divided by cutting a section of the rhizome with four to six pseudobulbs, which were carefully washed with drinking water and then immersed in a water solution with Captan® 500 fungicide (1 g L^{-1}) for 10 min (Figure 2).

The average characteristics of the plants were: pseudobulbs 2.43 cm thick and 6.85 cm long, generally with three leaves 4.7 cm wide and 19.7 cm long, on average.

Establishment of the experiment

The prepared *L. anceps* plants were attached to the phorophyte trunk with plastic string at a height of 1.2 to 2.0 m in each of the four different phorophytes (Figure 3). The height of the phorophytes ranged from 5.6 to 10.9 m, the diameter at chest height (DCH) ranged from 25.3 to 57 cm (Table 1), and the different shades and textures of the bark (Figure 4). Moisture was maintained with manual water jet irrigation, twice a week.

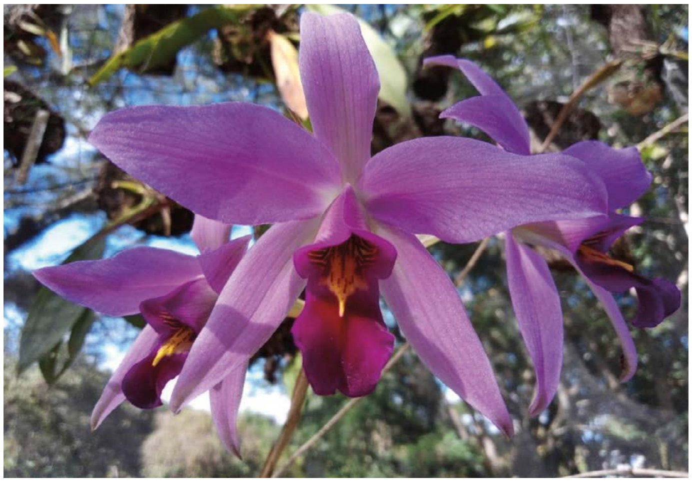


Figure 1. Inflorescence of *Laelia anceps* Lindl.

Figure 2. *Laelia anceps* Lindl. plant prepared for attachment to a phorophyte.

Figure 3. Establishment of *Laelia anceps* Lindl.

Table 1. Phorophyte characteristics selected for the study.

Scientific name (Common name)	**Height (m)**	**DAH (cm)**	**Bark type**	**Bark color**
Persea schiedeana Nees. (aguacate criollo)	6.1	54.1	Widely ribbed	Dark brown
Fraxinus sp. (fresno)	5.6	25.3	Fissured	Greyish brown
Swietenia macrophylla King. (caoba)	10.9	57.0	Slightly fissured	Greyish brown
Tecoma stans (L.) Juss. ex Kunth. (lluvia de oro)	7.2	54.0	Scaly and widely fissured	Dark brown

DCH=Diameter at chest height.

The average temperature during the study period was 21.7 °C. The average relative humidity was 73.1% (Figure 5).

Figure 4. Bark of the phorophytes used. A) *Persea schiedeana* Nees, B) *Fraxinus* sp., C) *Swietenia macrophylla* King, and D) *Tecoma stans* (L.) Juss. ex Kunth.

Experimental design and data analysis

The experiment was established in a completely randomized experimental design with four treatments (phorophytes): *Swietenia macrophylla* King, *Fraxinus* sp., *Persea schiedeana* Nees., and *Tecoma stans*. (L.) Juss. ex Kunth, with five replicates per phorophyte and three plants of the orchid *L. anceps* in each phorophyte. For each of the three specimens of *L. anceps*, the following variables were recorded: root emergence (number of days), root length (cm), root thickness (cm) and plant survival (percentage). These variables were measured 28 weeks after establishment of the orchids in the phorophytes. The data obtained were processed in the IBM SPSS Statistics software (version 21). An analysis of variance (ANOVA) was performed, followed by Tukey's test ($p \leq 0.05$), in order to know significant differences between treatments.

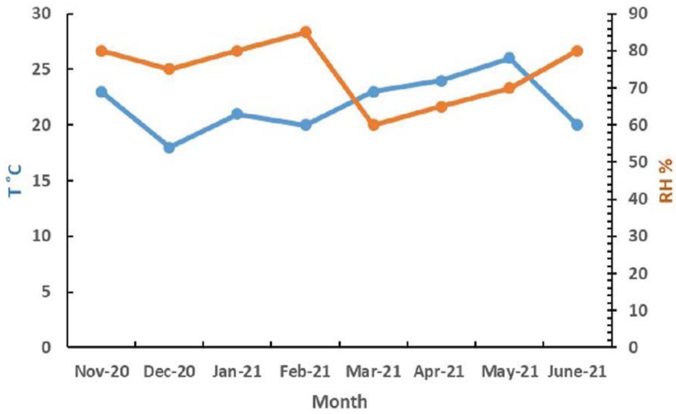


Figure 5. Temperature and relative humidity during the study period.

RESULTS AND DISCUSSION

After 28 weeks of establishing specimens of *L. anceps*, significant differences were observed in the different phorophytes evaluated. In root emergence, an early response was obtained in *S. macrophylla* and *Fraxinus* sp. trees, with 52 and 54 days, respectively, and a similar response was observed in root length of both *S. macrophylla* and *Fraxinus* sp., with 19.11 and 18.22 cm, respectively. The behavior of *L. anceps* on hosts *S. macrophylla* and *Fraxinus* sp. with fissured and slightly fissured bark, respectively, favored early emergence of new roots and longer root length. These observations are in agreement with the research by Hernández-Pérez *et al.* (2018) in which a higher wealth and abundance of orchids was found in 23 species of fissured-bark trees and a lower wealth in 12 species of smooth-bark trees. Similarly, Alzate-Q *et al.* (2019) found that the phorophyte *Clethra macrophylla* presented a higher richness of epiphytic species (41%) related to its multiple branches and rough bark. In contrast, studies by Zotarelli *et al.* (2018) showed that the bark of the phorophyte does not influence the number of orchids it can host. This would seem to reject the suggestion that the type of bark of both phorophytes does not positively influence root emergence in the specific case of *L. anceps*, since they have fissured bark, which may be ideal for root development.

The root thickness of *L. anceps* was very similar to that of *Fraxinus* sp. (0.28 cm), *S. macrophylla* (0.25 cm) and *P. schiedeana* (0.22 cm), and clearly superior to *T. stans* (0.06 cm). For the number of roots, similar results were also obtained for the same three species, which are also superior to *T. stans* (Table 2).

The poor root development of *L. anceps* in the *T. stans* phorophyte may be linked to the type of scaly, light and widely fissured bark that hosts few epiphytic plants, compared to the other phorophytes. This seems to agree with the findings by Yam *et al.* (2014), who found a lower presence of orchids and other epiphytic plants in phorophytes with soft (light) bark, within an urbanized landscape.

Regarding the survival of *L. anceps* plants in the phorophytes, in *S. macrophylla* and *Fraxinus* sp. there was 100% survival, in *P. schiedeana* there was 77% survival, and in *T. stans* there was only 33% survival (Table 2).

A possible reason for the differences in survival may be due to the morphological characteristics of the bark of *T. stans*, which do not facilitate orchid establishment, because

Table 2. *Laelia anceps* Lindl. development in four phorophytes in five variables.

Phorophyte	Root emergence (days)	Root length (cm)	Root thickness (cm)	Root number	Survival (%)
Persea schiedeana Nees. Aguacate criollo	78.38±7.80 b*	8.89±2.01 b	0.22±0.04 a	17.67±3.60 b	77±5.92 b
Fraxinus sp. Fresno	54.89±7.50 a	18.22±0.81 a	0.28±0.01 a	26.71±2.75 ab	100±0.00 ab
Swietenia macrophylla King. Caoba	52.56±1.60 a	19.11±2.62 a	0.25±0.01 a	32.45±2.57 a	100±0.00 a
Tecoma stans (L.) Juss. Ex Kunth Lluvia de oro	99.78±0.22 c	1.11±0.77 c	0.06±0.03 b	0.89±0.88 c	33±6.73 c

The mean ± standard error. * The means of the columns followed by different letters are statistically different (Tukey, $p \leq 0.05$).

it retains less moisture than the other species, given that all treatments received the same amount of irrigation. Segovia-Rivas *et al*. (2018) pointed out that humidity plays a decisive role in the acclimatization of orchids in phorophytes, so it is recommended to apply constant irrigation, when environmental conditions are very dry.

The data suggest that phorophyte type and constant irrigation can ensure the survival of *Laelia anceps* in disturbed rural landscapes. Coupled with the above, Einzmann and Zotz (2017) conclude that orchids can overcome connectivity barriers in the landscape. The authors also pointed out that the size and diversity of the landscape fragment are factors that define the presence of the microclimatic conditions necessary for their development. For Izzudin *et al*. (2018), the reintroduction of native orchids in anthropized landscapes is a viable method to ensure the continuity of species. In addition, they noted that efforts should be made to make appropriate management of these fragments to convert them into refuges for native epiphytic orchids which is in agreement with Nurfadilah (2015).

CONCLUSIONS

The data from this experiment suggest that adaptation of *L. anceps* plants in an urbanized environment is possible, if suitable phorophyte species are determined to allow good root development. In this sense, the best phorophytes for the establishment of *L. anceps* were *S. macrophylla* (mahogany) and *Fraxinus* sp. (ash) with 100% survival, given their greater root development.

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