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CATASETUM × *VILHENENSE* (ORCHIDACEAE: CATASETINAE), A NEW NATURAL HYBRID FROM THE AMAZON FOREST

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Abstract. Krahl, D. R. P.; M. S. de Oliveira, P. Schmal, A. H. Krahl, G. Chiron, J. B. F. da Silva & P. de C. Cantuária. 2024. *Catasetum* × *vilhenense* (Orchidaceae: Catasetinae), a new natural hybrid from the Amazon forest. *Darwiniana*, nueva serie 12(2): 308-317.

This study describes a new natural hybrid of *Catasetum, C.* × *vilhenense*, from the State of Rondônia (Brazil) found in ombrophilous forests near the Roosevelt River. The hybrid shows intermediate morphological features between its parental species, *C. ariquemense* and *C. multifidum*, with specific differences in floral morphology and inflorescence structure. We provide detailed data on its habitat, ecology, and geographic distribution, and a photographic plate of the hybrid. Given its restricted range, limited to a single locality with an area of occupancy (AOO) of less than 10 km², *C.* × *vilhenense* may be Critically Endangered (CR) due to habitat loss and fragmentation. An identification key is also proposed for the species and natural hybrids of *Catasetum* with symmetrical and parallel antennae in the state of Rondônia, contributing to the understanding and classification of this genus in the Amazon forest.

Keywords. Amazon basin; biodiversity; hybridization; orchid; State of Rondônia; taxonomy.

Resumen. Krahl, D. R. P.; M. S. de Oliveira, P. Schmal, A. H. Krahl, G. Chiron, J. B. F. da Silva & P. de C. Cantuária. 2024. *Catasetum* × *vilhenense* (Orchidaceae: Catasetinae), un nuevo híbrido natural de la selva amazónica. *Darwiniana*, nueva serie 12(2): 308-317.

Este estudio describe un nuevo híbrido natural de *Catasetum, C.* × *vilhenense*, del estado de Rondônia (Brasil), encontrado en bosques ombrófilos cerca del Río Roosevelt. El híbrido muestra características morfológicas intermedias entre sus especies parentales, *C. ariquemense* y *C. multifidum*, con diferencias específicas en la morfología floral y la estructura de la inflorescencia. Proporcionamos datos detallados sobre su hábitat, ecología y distribución geográfica, y una lámina fotográfica del híbrido. Dada su distribución restringida, limitada a una única localidad con un área de ocupación (AOO) inferior a 10 km², *C.* × *vilhenense* puede encontrarse en Peligro Crítico (CR) debido a la pérdida y fragmentación de su hábitat. También se propone una clave de identificación para las especies e híbridos naturales de *Catasetum* con antenas simétricas y paralelas en el estado de Rondônia, contribuyendo a la comprensión y clasificación de este género en la selva amazónica.

Palabras clave. Biodiversidad; cuenca amazónica; Estado de Rondônia; hibridación; orquídeas; taxonomía.

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INTRODUCTION

Among the genera sorted into the subtribe Catasetinae, *Catasetum* Rich. ex Kunth stands out for comprising the greatest number of species (Chase et al., 2015). It is widely distributed in the Neotropical area, occurring from Mexico to southern Brazil and northern Argentina (Romero & Jenny, 1993; Romero & Carnevali, 2009). It is comprised of 193 accepted species (Romero & Jenny, 1993; Calderón-Álvarez & Bonilla-Moralez, 2023; Krahl et al., 2023a, 2023b, 2023c, 2023d, 2023e, 2023f; 2024a, 2024b; POWO, 2024) and 41 natural hybrids (Krahl et al., 2020, 2023a, 2024c; Cantuária et al., 2021; Ferreira & Malaspina, 2023a, 2023b; Assis & Ferreira, 2024; POWO, 2024; Romero-González & Carnevali, 2024). In practice its members are not distinguishable on the basis of the vegetative morphology and they are, therefore, differentiated thanks to the morphological diversity of the staminate flowers (Holst, 1999). Historically, the infrageneric classification of the genus has relied on the presence, absence, and configuration of staminodes (known as antennae) located in the column (gynostemium) of the staminate flowers (e.g. Cogniaux, 1904; Mansfeld, 1932; Bicalho & Barros, 1988; Senghas, 1990, 1991; Pabst & Dungs, 1977). However, a recent phylogenetic study (Mauad et al., 2022) indicates that the groups based on the morphology of this structure are not supported as natural clades in any of the available phylogenetic reconstructions, proving to be polyphyletic lineages. The species are thus best grouped according to biogeographical criteria (Mauad et al., 2022).

The absence of a phylogenetic model in *Catasetum* is likely due to the extensive hybridization events that occurred historically, which have prevented the genus from achieving genetic stability (Mauad et al., 2022). Furthermore, the increase in taxon richness for the genus is notable, which is evidenced by the numerous recent descriptions of new species and new nothospecies (e.g. Valsko et al., 2019; Krahl et al., 2020, 2021a, 2021b, 2022a, 2022b, 2023a, 2023b, 2023c, 2023d, 2023e; 2024a, 2024b, 2024c; Petini-Benelli & Chiron, 2020; Cantuária et al., 2021; Dámian et al., 2021; Calderón-Álvarez & Bonilla-Moralez, 2023; Ferreira & Malaspina, 2023a, 2023b; Assis & Ferreira, 2024; Romero-González & Carnevali, 2024). We also emphasize that it has been discovered that many of the taxa described as species are in fact natural hybrids (Petini-Benelli & Grade, 2012; Krahl et al., 2023a, 2024c; Romero-González & Carnevali, 2024) and we understand that the taxonomic status of these nothospecies could not be revealed by phylogeny alone due to the formation of clades with taxa without any morphological similarity (Mauad et al., 2022). Therefore, in addition to morphological analysis, other tools can help to elucidate this problem, such as population genetic and cytogenetic studies (Mauad et al., 2022) or even through artificial crossing between different species and subsequent *in vitro* germination, as demonstrated by Romero-González et al. (2017) and Krahl et al. (2024c). However, we highlight that the use of these tools requires resources and time, therefore, limitations are imposed.

Brazil is the country which presents the greatest number of natural hybrids of *Catasetum* (POWO, 2024). It currently houses 31 nothospecies (Krahl et al., 2020, 2023a; 2024c; Barberena, 2021; Cantuária et al., 2021;Ferreira & Malaspina, 2023a, 2023b; Assis & Ferreira, 2024; Petini-Benelli, 2024), with a large concentration in the Amazon forest that has 22 natural hybrids (Krahl et al., 2020, 2023a; Barberena, 2021; Cantuária et al., 2021; Ferreira & Malaspina, 2023a, 2023b; Petini-Benelli, 2024). About 41% of these hybrids (i.e. nine nothospecies) are concentrated in the State of Rondônia which is entirely located within the Amazon forest (Ferreira & Malaspina, 2023a, 2023b; Petini-Benelli, 2024).

The state of Rondônia stands out for its high rates of deforestation in the Amazon forest and is among the three states that have deforested the most in the Brazilian territory (Guimarães et al., 2024). As a consequence, this deforestation leads to the fragmentation of vegetation as a whole and directly impacts biodiversity in its entirety (Leal et al., 2019). This change in the landscape promoted by humans in the state of Rondônia may be one of the explanations for the high number of *Catasetum* nothospecies found in this state, since, according to Krahl et al. (2023), the removal of vegetation and subsequent emergence of pastures would allow more easily gene flow between different species of this genus that, otherwise, would never have come into contact with each other if the natural barrier (vegetation) had not been removed. In view of this context, it is expected that more nothospecies of *Catasetum* could emerge in the state of Rondônia.

Therefore, the objective of this work is to propose a new natural hybrid of *Catasetum* from the southern region of Rondônia, which is morphologically compared to the parental species.

MATERIALS AND METHODS

The new nothospecies has been collected in a stretch of Ombrophilous Forest, near the Roosevelt River in the municipality of Vilhena, in the south of the State of Rondônia, by the border with the State of Mato Grosso in Brazil. The specimens were herborized following the standard protocol described by Mori et al. (1989) and Peixoto &

Maia (2013) and subsequently incorporated into the HUAM herbarium collections. Vegetative and floral parts were measured using a hand caliper rule and the flowers were analyzed from fresh material, the perianth being distended, mounted and photographed. Photographs were made using a Canon T5 camera with a Canon EFS 18-55 mm lens. Field notes on habitat, ecology, and phenology were recorded "in situ". Morphological terminology follows Dressler (1993) and Gonçalves & Lorenzi (2007). The preliminary conservation status is based on IUCN criteria (2022), however we emphasize that IUCN does not officially recommend assessing the conservation status of hybrids. The geographical distribution map was made using the QGIS 3.28.0-Firenze software.

The morphological comparison of the new taxon and its parents was based on various sources: I) living specimens that we have in cultivation; II) analysis of different materials preserved and deposited in different herbaria; and III) analysis of protologues and types of *C. ariquemense* F. E. L. Miranda & K. G. Lacerda (Miranda & Lacerda, 1992; HB88757!) and *C. multifidum* F. E. L. Miranda (Miranda, 1986; RB288851!). We also studied specimens of *Catasetum* preserved in different botanical collections that represent the main regional herbaria and/or most representative herbaria of northern Brazil or with collections of the genus for Rondônia. Finally, we did not find any material fitting the new taxon. Herbaria of which material was analyzed and studied were: BHCB, CEN, EAFM, HB, HCF, HPIN, HSTM, HUAM, IAN, INPA, K, MG, MO, RB, RON, UB and UPCB (acronyms according to Thiers, 2024). Based on occurrences cited by Ferreira & Malaspina (2023a, 2023b) and Petini-Benelli (2024), we propose an identification key to the species and nothospecies occurring in Rondônia and presenting symmetrical and parallel antennae, a character observed in the nothospecies here described.

RESULTS AND DISCUSSION

Taxonomic treatment

Catasetum × vilhenense D. R. P. Krahl, Krahl, J. B. F. Silva & Cantuária, **hybr. nov.** (= *C. ariquemense* × *C. multifidum*). TYPE: BRAZIL. Rondônia. Vilhena, near the Roosevelt River, 12°23'21.7"S 60°12'45.7"W, 19-VII-2023, *E. A. Lacerda sub A. H. Krahl 1707* (holotype: HUAM012675; isotype: HUAM012676), figs. 1-2.

Diagnosis. Hybrida naturalis cum characteribus intermediis inter *C. ariquemense* et *C. multifidum*: inflorescentia arcuata, pendente ob florum pondus, floribus flavovirentibus cum maculis fuscis resupinatis, labello ambito triangulare trilobato fimbriato, fimbriis apice irregulariter divisis, callo basale tripartito, callo apicale oblongo apice simplice vel in 2-4 puncta irregulariter diviso.

Plant epiphytic and caespitose. Rhizome inconspicuous, short. Pseudobulb 7.9-18.5 × 1.7- 2.3 cm, fusiform to oblongoid, 7-9-leaved, covered by the leaf sheaths. Leaves 7.4-22.5 × 4.1-8.4 cm, oblanceolate, plicate, with 5-7 prominent nerves on the abaxial face, membranous, green, margin entire and slightly wavy, apex acute. Staminate inflorescence 21.1-25.9 cm, arched and descendant with the weight of the flowers, lateral, racemose, 17-21-flowered; peduncle cylindrical, slightly brownish and yellowish-green; floral bract ca. 0.7 × 0.3 cm, lanceolate, greenish, margin entire, apex acute. Staminate flowers yellowish with irregular brownish spots, resupinate, grouped in the apical two thirds, pedicelled; pedicel ca. 1.9 × 0.2 cm, cylindrical, erect, slightly brownish; dorsal sepal ca. 2.6 × 0.9 cm, elliptic, concave, symmetrical, margin entire, apex acute; lateral sepals ca. 2.9 × 1.1 cm, elliptic, concave, asymmetrical, margin entire, apex acute; petals ca. 2.7 × 0.7 cm, elliptic, symmetrical, margin entire, apex acute; lip ca. 1.6 × 1.7 cm, triangular in scope, trilobed, margin bordered by fimbriae irregularly divided at the apex, with a basal and an apical calluses; lip bottom ca. 0.7 cm deep, conical; lateral lobes ca. 0.8 × 0.6 cm, rounded, ending in fimbriae with a compound apex; midlobe ca. 1 × 0.5 cm, triangular, margin bordered at base by short fimbriae with compound apex becoming smooth towards apex, apex acute; basal callus 0.5 × 0.4 cm, tripartite in appearance; apical callus 0.5 × 0.2 cm, oblong, attenuated, with acute apex or with the apex irregularly subdivided into two to four points; column ca. 2 × 0.5 cm, oblanceolate, thick, yellowish-green with discreet brownish dots at base, slightly contracted at base, apex rostrate; antennae ca. 0.7 cm, filiform, parallel, yellowish; anther cap ca. 0.7 × 0.2 cm, subtriangular, yellowish-green, apex rostrate; viscidium ca. 0.1 × 0.1 cm, subquadrate, sticky; stipe ca. 0.2 × 0.1 cm, laminar, rolled, yellowish; pollinia 2, ca. 0.2 × 0.1 cm, oblong, hard, sulcate, compressed, yellowish. Pistillate and hermaphrodite structures not seen. Fruit not seen.

Etymology. The specific epithet refers to the municipality of Vilhena (Rondônia, Brazil), where the type material of the nothospecies comes from.

Distribution and habitat. Hitherto the new taxon has only been recorded from the type locality. This place consists of a stretch of Ombrophilous Forest within the Brazilian Amazon forest located at ca. 50 km from the north of the city of Vilhena (municipality of Vilhena, south of Rondônia)

Fig. 1. Composite color plate of *Catasetum* × *vilhenense*. **A,** inflorescence. **B,** floral bract. **C-E,** Flowers. **F,** Floral segments. **G,** detail of the lip fimbriae. **H-K,** lip. **L-N,** gynostemium (column). **O,** anther cap and pollinarium. Plate and photographs by A. H. Krahl.

Fig. 2. Material type of *Catasetum* × *vilhenense*. **A,** holotype (HUAM 012675). **B,** isotype (HUAM 012676).

(Fig. 3). It is an epiphytic species that has been observed growing on trees near the Roosevelt River. As *C.* × *vilhenense*, the parent species have been described from the State of Rondônia (Miranda, 1986; Miranda & Lacerda, 1992). Moreover, there have been records of *C. multifidum*, one of the parents, from the municipality of Vilhena (see below the list of material examined).

Preliminary conservation status. *Catasetum* × *vilhenense* is known from only one apparent population growing in the Brazilian Amazon in the state of Rondônia. Since it is known from a single location, it was not possible to infer data on the extent of occurrence (EOO), while the area of occupancy (AOO) is estimated at 4 km², falling into the Critically Endangered (CR) category, considering the IUCN (2022) criterion B2. We can also consider that the Amazon forest, especially the areas of the state of Rondônia (vegetation where the taxon is present), has been reduced into several scattered fragments due to extensive human occupation, which allows us to project a possible continued decline in the area of occupancy (bii) and in the habitat quality (biii) of *C.* × *vilhenense*. Furthermore, because it is a taxon known from only one population, we believe that the number of individuals is quite below 250 (=CR). Therefore, according to the IUCN (2022) guidelines, the taxon can be treated as CR (Critically Endangered) based on criterion B: B2b(ii, iii).

Phenology. In cultivation the new hybrid start blooming in mid-July. The flowers last about 15 days and each new pseudobulb can produce up to three inflorescences until the months of December and January. Vegetative growth, including the emission and development of new shoots, occurs during the first half of the year.

Taxonomic notes. According to the usual infrageneric classification, based on the presence/lack and disposition of antennae, the new nothospecies is a member of the subgenus *Catasetum* sect. *Isoceras* (Mansf.) Senghas subsect. *Isoceras* Mansf. as it presents symmetrical and clearly parallel antennae (Bicalho & Barros, 1988; Senghas, 1991). As mentioned earlier, this classification is not supported by Mauad et al. (2022). However, it remains in use because no alternative morphological features currently allow for a more robust taxonomic separation.

Catasetum × *vilhenense* shows characters intermediate between those of two species first described from Rondônia, *C. ariquemense* and *C. multifidum* (Miranda, 1986; Miranda & Lacerda,

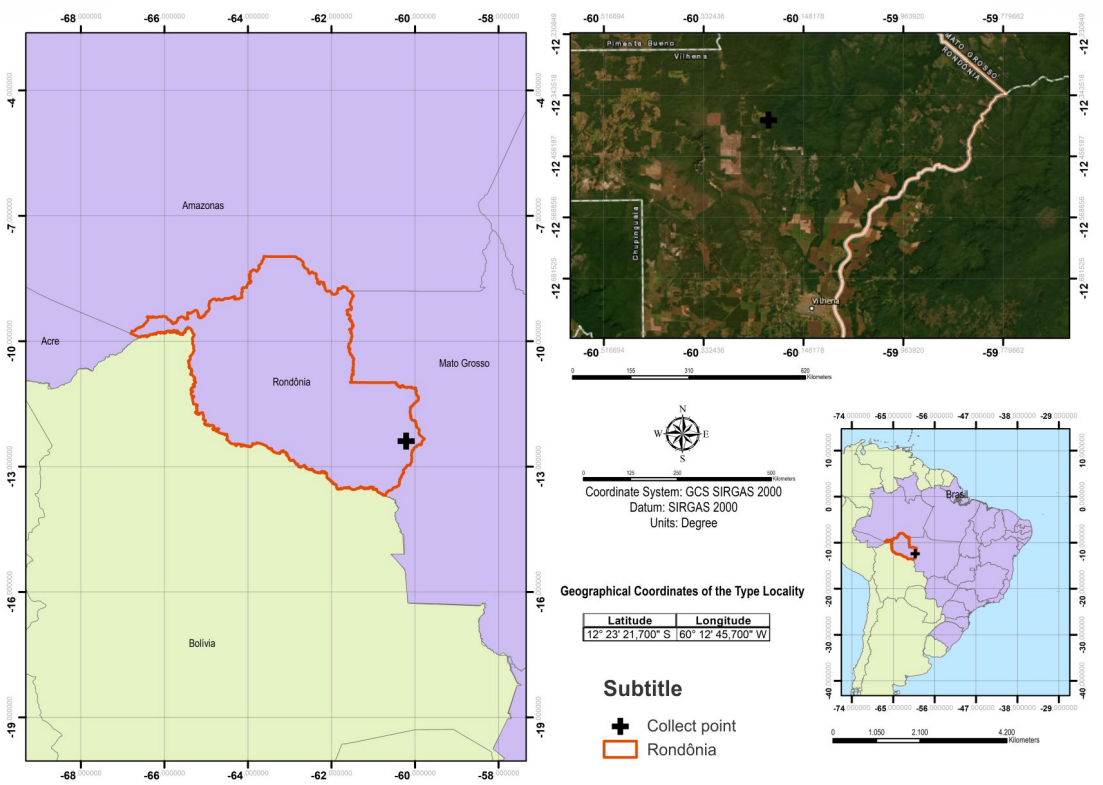

Fig. 3. Location of the type locality of *C.* × *vilhenense*.

1992; Petini-Benelli, 2024) (Fig. 4) (Tab. 1). This feature allows a reliable inference of its taxonomic status as a nothospecies. As for most taxa in the genus it is not possible to find diagnostic vegetative traits because they share the same characters (Holst, 1999; Walker-Larsen & Harder, 2000).

The morphology of the staminate flowers displays several intermediate characteristics between the parental species. The inflorescence is arched and descendant, similar to both parents (predominantly *C. multifidum*), and the flowers exhibit a color pattern closely resembling certain variations of *C. ariquemense* and *C. multifidum*. They have a yellowish hue (as in some variations of *C. multifidum*) lightly greenish (as in *C. ariquemense*) with irregular brownish stains as in both parents. The lip is 3-lobed and fimbriate as in its parents, however the fimbriae have a composed apex as in *C. multifidum*, whereas they present an entire apex in *C. ariquemense*. The basal callus of the lip is tripartite as in both parents and the lip has an apical callus as observed in *C. ariquemense*. However, because the lip of *C. multifidum* ends attenuatedly with the multifidus apex, the apical callus of *C.* × *vilhenense* is oblong and acuminate with an apex either simple or irregularly divided into 2-4 points (*vs*. oblong, apically obtuse to denticulate in *C. ariquemense*). The hybrid has the symmetrical parallel antennae characteristic of both parents (Miranda, 1986; Miranda & Lacerda, 1992; Petini-Benelli, 2024).

Specimens examined. [*Catasetum ariquemense*] BRAZIL. **Rondônia**. Ariquemes, III-1991, *K. G. Lacerda Jr. 278* (HB!); *idem*, V-1998, *L. C. Menezes 74* (UB!); Jamari, margem esquerda do rio Jamari, II-1991, *J. B. F. da Silva & M. F. F. da Silva 163* (MG!); *idem*, Rio Preto, 6-II-1994, *J .B. F. da Silva 321* (MG!), Machadinho D'Oeste, 09°06'27"S 62°13'12"W, 31-III-2014, *A. Petini-Benelli & S. C. Freitas 272* (RB!). [*Catasetum multifidum*] BRAZIL. **Pará.** Carajás, II-1991, *K. G. Lacerda Jr. & J. B. F. da Silva s.n.* (BHCB81240!); *idem*, *K. G. Lacerda Jr. 368* (BHCB!); Curionópolis, Serra Leste, 30-V-2018, *J. B. F. da Silva 5363* (HSTM!); *idem*, 04-VI-2018, *J. B. F. da Silva 5208* (HSTM!); São Félix do Xingu, Serra de Campo, 22-IV-1995, *J. B. F. da Silva 386* (MG!); **Rondônia.** Cacoal, II-1993, *K. G. Lacerda Jr. 377* (BHCB!); Ji-Paraná, IV-1984, *F. Miranda 804* (RB!); Vilhena, 1981, without collector (MG140892!);

Fig. 4. Composite color plate with the comparison between *Catasetum* × *vilhenense* and its parents. **A,** *C.* × *vilhenense*. **B,** *C. ariquemense*. **C,** *C. multifidum*. Photographs A and B by A. H. Krahl; C by E. A. Lacerda.

Table 1. Main comparative characteristics between *Catasetum* × *vilhenense* and the parental species.

CHARACTERS	TAXA		
	C.* × *vilhenense	***C. ariquemense***	***C. multifidum***
Inflorescence	Arched and descendant with the weight of the flowers, 17-21-flowered	Arched and descendant with the weight of the flowers, 3-20-flowered	Arched and slightly descendant with the weight of the flowers, 2-20-flowered
Flowers	Yellowish with irregular brownish spots, resupinate	Yellowish-green with irregular brown spots, resupinate	Purple or yellowish-green/ yellow with irregular brownish stripes, resupinate
Lip	Trilobed, triangular in scope, margin bordered by fimbriae irregularly divided at the apex, with a basal and an apical calluses	Trilobed, subtriangular in scope, margin bordered by fimbriae with a simple apex, with a basal and an apical calluses	Trilobed, triangular in scope, margin bordered by fimbriae irregularly divided at the apex, with a basal callus
Lateral lobes	Rounded, ending in fimbriae with a compound apex	Rounded, ending in fimbriae with a simple apex	Rounded, ending in fimbriae with a compound apex
Midlobe	Triangular, margin bordered at base by short fimbriae with compound apex becoming smooth towards apex	Triangular, margin bordered at base by short fimbriae with a simple apex	Attenuated with fimbriae with compound apex at base and becoming smooth towards apex, apex multifid
Basal callus	Tripartite in appearance	Tripartite in appearance	Tripartite in appearance
Apical callus	Oblong, attenuated, with acute apex or with the apex irregularly subdivided into two to four points	Oblong, robust, with irregularly divided apex	Absent
Antennae	Symmetrical, parallel	Symmetrical, parallel	Symmetrical, parallel

Identification key to Catasetum species and nothospecies with symmetrical and parallel antennae occurring in the State of Rondônia (Brazil)

1. Not resupinate flowers..... 2
1. Resupinate flowers..... 4
2(1). Pendulous inflorescence..... *C. × incarnatum*
2. Erect to arched inflorescence..... 3
3(2). Interior of the lip bordered by lamellae..... *C. ferox*
3. Interior of the lip with a triangular callus flanked by low crests arranged in a fan..... *C. hopkinsonianum*
4(1). Lip entire..... 5
4. Lip 3-lobed or subtrilobed..... 6
5(4). Basal callus of the lip irregularly tridentate..... *C. × nogueirae*
5. Basal callus of the lip made of a central acute protuberance from which 3-4 semicircular rows of small denticles laterally start..... *C. semicirculatum*
6(4). Lip margin serrate, denticulate or verrucose..... 7
6. Lip margin fimbriate.....10
7(6). Lip without any basal callosity..... *C. × ornaghiae*
7. Lip with some type of callosity at base..... 8
8(7). Each lip lateral lobe with an uncinate callus..... *C. rondonense*
8. Base of the lip with a single callus.....9
9(8). Basal callus truncate and low..... *C. parguazense*
9. Basal callus tridentate or bipartite..... *C. × mesquitae*
10(6). Lip apex without any callosity..... *C. osakadianum*
10. Lip apex with some type of callosity.....11
11.(10). Basal callus subtrapeziform..... *C. × perazolianum*
11. Basal callus tridentate.....12
12(11). Lip midlobe ending into a multiciliate appendix..... *C. multifidum*
12. Lip midlobe triangular.....13
13(12). Lip fimbriae with a simple apex; apical callus of the lip robust and apically denticulate .... *C. ariquemense*
13. Lip fimbriae with a composed apex (divided); apical callus of the lip oblong either simple or irregularly divided into 2-3 points at apex..... *C. × vilhenense*

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