# A NEW SPECIES OF *KEFERSTEINIA* (ORCHIDACEAE: ZYGOPETALINAE), WITH PECULIAR NON-RESUPINATE FLOWERS

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**Abstract.** In this study, a new species of the genus *Kefersteinia* is described and illustrated. This species was discovered in the forests of the Tolima department of Colombia. Details about its distinctive morphology are provided, along with a comparison with the closest species in the same genus. Additionally, information regarding its distribution, habitat, and phenology is also furnished.

**Keywords:** Orchid, Resupination, Systematics, Taxonomy, University of Tolima

**Resumen.** En este estudio, se describe y se ilustra una nueva especie del género *kefersteinia*, que se descubrió en los bosques del departamento del Tolima, Colombia. Se proporcionan detalles sobre su morfología distintiva y se establece una comparación con las especies más cercanas dentro del mismo género. Se proporciona información sobre su distribución, hábitat y fenología.

**Palabras claves:** Orquídea, Resupinación, Sistemática, Taxonomía, Universidad del Tolima

In 1852, the eminent German botanist, Heinrich Gustav Reichenbach, established the taxonomic foundation of the genus *Kefersteinia* Rchb.f., naming it in recognition of Mr. Keferstein, an influential 19th-century German orchid horticulturist (Reichenbach, 1852). Within the scope of *Kefersteinia*, a diverse taxonomic range is evident, encompassing an estimated 60 to 70 recognized species to date (Pupulin et al., 2009; POWO. 2023).

Species of *Kefersteinia* have a broad distribution, extending from southern Mexico to Panama and countries in South America, including Venezuela, Colombia, Suriname, Ecuador, Peru, and Bolivia. The presence of this genus is notable in the mountainous enclaves of Central America, from southern Mexico reaching as far as Costa Rica. In the range from Guatemala to southern Mexico, the diversity of this genus sharply decreases, with *K. tinschertiana* Pupulin and *K. lactea* (Rchb.f.) Schltr. being the only recorded species in that region. Furthermore, *Kefersteinia* exhibits a limited presence in the Amazon's lowlands and the Guiana region (Carnevali et al., 2007; Carnevali et al., 2015; Pupulin and Merino, 2008). In Colombia, 22 species from this genus have been identified so far, six of which are endemic (Ministerio de Ambiente y Desarrollo Sostenible and Universidad Nacional de Colombia, 2015).

From a morphological perspective, species of *Kefersteinia* are typically small-sized plants without pseudobulbs. They have slender, mostly pendant inflorescences, and a flower with a basal, and generally bilobed, callus. The column often bears a laminar ventral plate and a central keel (Pupulin, 2001).

Within the nomenclature of the genus, several authors have traditionally distinguished two morphologically distinct groups. The first group corresponds to species with flowers structurally similar to *Kefersteinia graminea* (Lindl.) Rchb.f., the type species of the genus, that is mainly found in the Andes. These species are characterized by having a very pronounced lateral fold in the middle of the lip blade and a sessile callus that is generally low and laminar. The second group, primarily distributed in Central America, with some species located along the Pacific coast of Colombia and Ecuador as well as in western Venezuela, includes species with a straight lip blade and a solid raised callus, as seen in *Kefersteinia wercklei* Schltr. However, molecularly, both groups do not form monophyletic entities, which hinders their formal recognition (Whitten et al., 2005).

Subtribe *Zygopetalinae*, within Orchidaceae, represents a natural group that spans throughout the entire American tropics, ranging from southern Mexico to northern Argentina, comprising 38 genera (Pupulin et al., 2009; pers. comm. to Sierra-Ariza, 2023). Morphologically, both in vegetative and floral aspects, this group exhibits astonishing diversity. While it is evident that resupinate flowers are a predominant feature in the subtribe, it is important to note that a few species, such as those belonging to the genus *Chaubardiella* Garay, *Benzingia hirtzii* Dodson, and *Kefersteinia carolorum* Carnevali & Cetzal, have non-resupinate flowers. In this context, we present a description and illustration of a new species of *Kefersteinia*, which is characterized by having non-resupinate flowers.

We want to express our most sincere gratitude to the distinguished researchers Franco Pupulin and Sebastian Moreno for their invaluable comments on the genus *Kefersteinia* and for generously sharing their deep knowledge on the taxonomy and study of orchids. Likewise, we extend our gratitude to the researchers Germán Carnevali, W. R. Cetzal-Ix, J. L. Tapia-Muñoz, and Gustavo A. Romero-González for allowing us to access to their texts, fugures, and herbarium material. These resources have been fundamental to the development of our research work and have contributed significantly to the quality and precision of our scientific article. Additionally, we wish to express our gratitude to the dendrology section of the TOLI Herbarium at the University of Tolima for receiving the type material of the new species. Their collaboration and support have been fundamental to our research.

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## Materials and Methods

The new species was discovered in October 2021 during a supplementary expedition for the research project titled "Síntesis de las orquídeas del río Azufrado, Tolima-Colombia". In this project, six new orchid species were discovered and published with the following names: *Acianthera villahermosae* Sierra-Ariza, Rinc.-González & Karremans, *Oncidium tolimense* Sierra-Ariza & A. Albino-Bohórquez, *Pleurothallis petroana* Sierra-Ariza, *Pleurothallis villahermosae* Sierra-Ariza, Rinc.-González, & Villanueva, *Epidendrum villahermosaense* Sierra-Ariza & Hágsater, and *Epidendrum rioazufrense* Sierra-Ariza, Hágsater & E. Santiago.

Images of the type specimen were captured using a Nikon D5300 camera equipped with a NIKKOR AF 105 mm f/2.8 D Micro lens. The specimen was preserved by storing its vegetative structures in newspaper soaked with 75% ethanol. Floral structures were kept in an equal mixture of glycerin and ethyl alcohol. The collected material was dried at a temperature of 75C for a period of 14 hours and subsequently incorporated into the collection of the Herbario TOLI at the University of Tolima.

A digital composite plate (LCDP) was generated using Adobe Photoshop® CS6. The drawings were created using the Procreate illustration application on a seventh-generation Apple iPad device.

## Taxonomic Treatment

**Kefersteinia universitatis-tolimae** Sierra-Ariza, *sp. nov.* TYPE: COLOMBIA. Tolima, Casabianca municipality, Hoyo Caliente vereda, 1790 m, 8 October 2021, *M. A. Sierra-Ariza 440* (holotype, TOLI). Fig. 1–3.

The species most similar to *Kefersteinia universitatis-tolimae* is *K. carolorum* Carnevali & Cetzal. However, it can be distinguished from the latter by having a nearly square-shaped callus on the lip when viewed from above (vs. slightly pandurate) with two rounded apical teeth (vs. acute) and no teeth on the lateral margins (vs. having approximately two teeth around the middle length).

*Plant* 7–19 cm tall, epiphytic, inclined, caespitose, stems very short and totally enveloped by leaf-sheaths, each shoot provided with 2–3 leaves and 2–4 acute basal sheaths. Roots terete, thick, white. *Leaves* 11–19 × 0.8–1.8 cm, linear-oblong, acute, narrowing at base to a conduplicate petiole. *Inflorescence* 2.5–3.0 cm long, 1-flowered, slender, suberect to arcuate-pendent, peduncle terete, green, with 2 internodes and with one peduncle bract at base 5 × 4 mm, a more distal one of 4 × 3 mm; floral bract double, the outer one broadly ovate, short acuminate, 5.0 × 3.5 mm, subopposite internal bractlet smaller, oblong-lanceolate, acuminate, 3.5 × 1.8 mm. *Ovary* terete-subclavate, triangular in section, valves deeply grooved to 6 mm long including the pedicel. *Flowers* non-resupinate, sepals pale green and petals occasionally with scarlet dots at the base, lip marked with small, clustered claret blotches, callus white with claret spots, column white, with a few small light claret spots, or without them. *Dorsal sepal* 11.0 × 5.5 mm, elliptic, acute, concave distally, abaxially subcarinate, 7-veined. *Lateral sepals* 13.0 × 5.5 mm, inserted along the margins of the column foot, oblong-elliptic, rounded to subacute, concave basally, dorsally slightly carinate along the mid-nerve, 7-veined, veins branched. *Petals* 11.5 × 6.5 mm, elliptic, acute to apiculate, irregularly erose, 7-veined, veins branched, dorsally slightly carinate along the mid-vein. *Lip* 14.5 × 17.0 mm, deeply concave at base, the apical half geniculate in natural position, suborbicular to slightly unguiculate when flattened, emarginate, apical margins erose and slightly undulate; callus 5.6 × 3.8 mm, emarginate directly from the base of the lip, subquadrate in general outline with upturned lateral margins narrow when viewed from above, apically forming two elliptic teeth, slightly flattened, rounded. *Column* 8.8 × 4.1 mm, including the foot, elongate, slender, lateral margins protruding at half-length to 2 semi-rounded wings, adaxial surface with an infrastigmatic keel, thin and long, sub-concave, abaxial and adaxial surfaces scabrous, ventral surface and foot with dark green trichomes. *Anther cap* cucullate, broad ovate, 2-celled. *Pollinia* 4 in two pairs of different sizes, obovate, on a triangular, folded stipe; viscidium hyaline, indistinct.

**Etymology:** The term "Universitatis-Tolimae" translates as "Of the University of Tolima." Its origin lies in two Latin words: "universitatis," which indicates possession or belonging to the university, and "Tolimae," which is the singular genitive of "Tolima," signifying the connection with the Tolima department in Colombia. The name honors and expresses gratitude for the remarkable history of the University of Tolima, which, for nearly eight decades, has provided higher education to both the Tolima department's community and individuals from other regions of Colombian territory. (Fig. 4A).

**Distribution and ecology:** *Kefersteinia universitatis-tolimae* Sierra-Ariza was discovered in a fragment of montane understory forest (bmh-MB or "bosque muy húmedo montano bajo") located in the Azufrado River basin, between the municipalities of Casabianca and Villahermosa, at the northernmost tip of the Tolima department in Colombia. This species grows at altitudes ranging from 1700 to 2000 meters above sea level as an epiphytic plant rooted in the understory of trees that exhibit a notable presence of bryophytes and limited exposure to direct sunlight. It's worth noting that this orchid shares its distribution with other species of the genus, such as *K. laminata* Rchb.f., *K.* aff *taggesellii* Neudecker, and *K. tolimensis* Schltr., all of which have been found in the Azufrado River basin.

Of particular interest is the chromatic variability observed within the same population of *K. universitatis-tolimae* Sierra-Ariza. Some of its plants have flowers with a greenish-white hue adorned with numerous scarlet-colored dots, while others exhibit pale white flowers with a few dots in a claret tone. This intrapopulation phenomenon of chromatic variation adds an intriguing aspect to the understanding of this species (Fig. 4B–C).

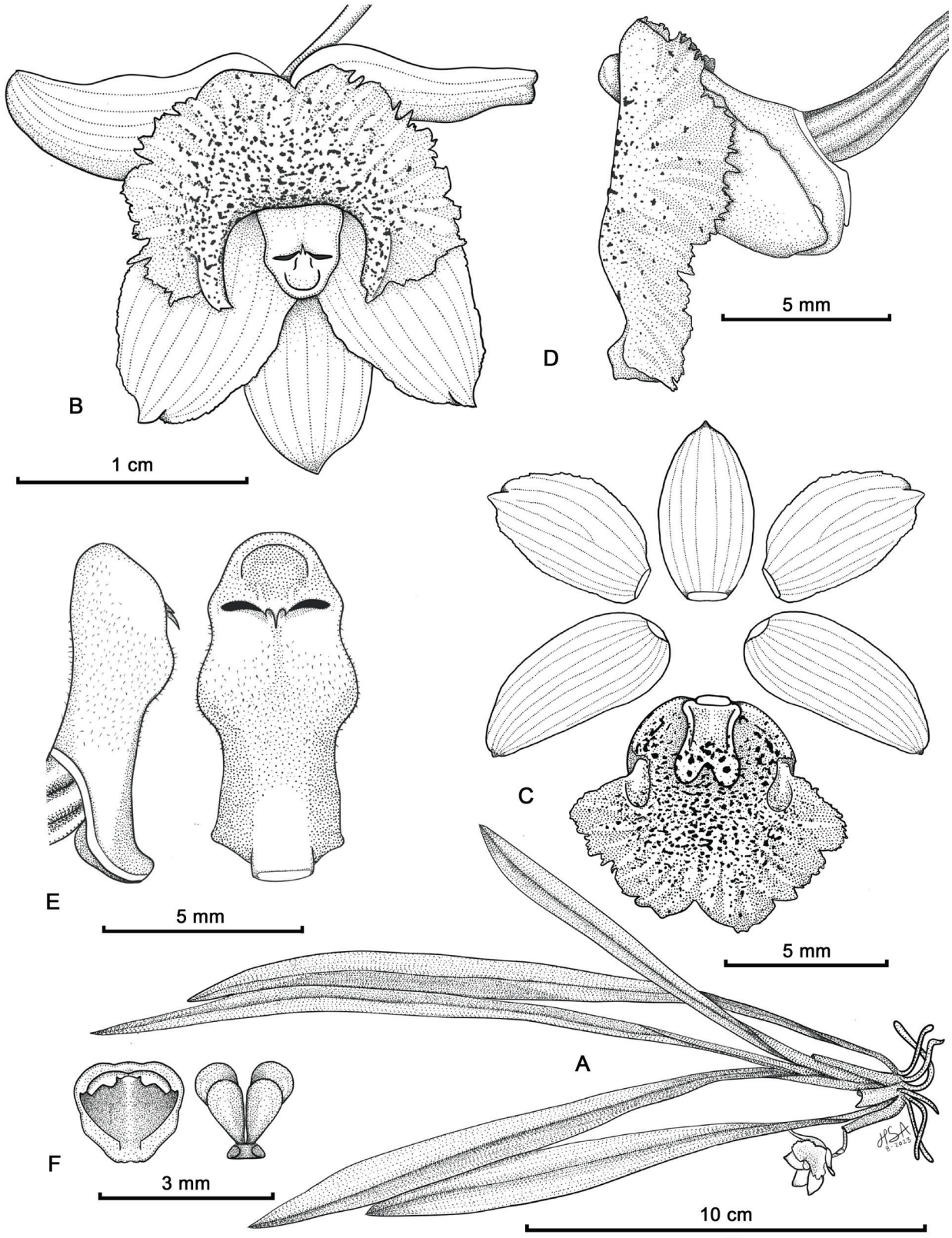


FIGURE 1. *Kefersteinia universitatis-tolimae* Sierra-Ariza. **A**, habit; **B**, flower; **C**, dissected perianth; **D**, lip and column lateral view; **E**, column, **F**, anther and pollinia. Illustration by M. A. Sierra-Ariza based on the holotype.

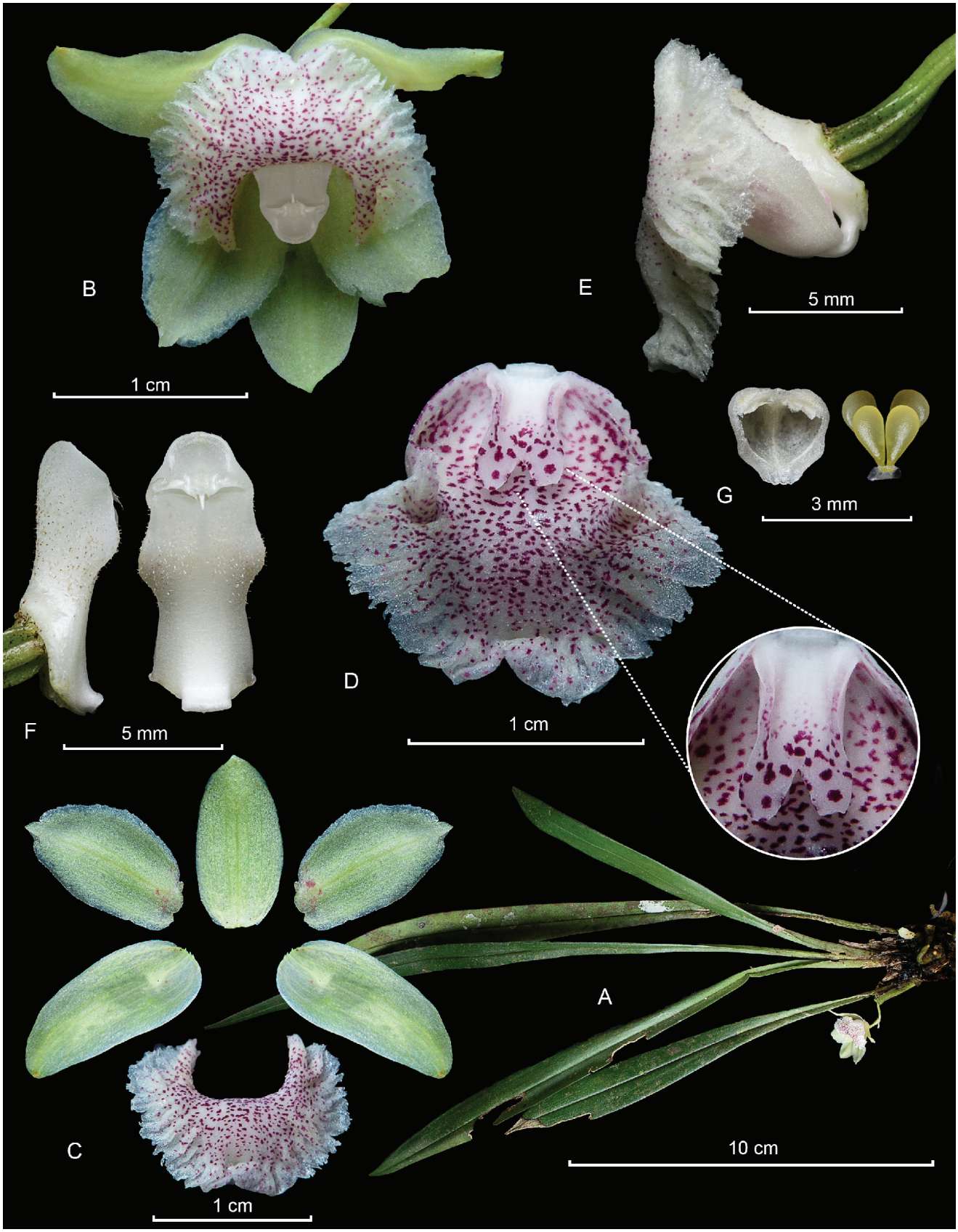


FIGURE 2. *Kefersteinia universitatis-tolimae* Sierra-Ariza. **A**, habit; **B**, flower; **C**, dissected perianth; **D**, lip; **E**, lip and column lateral view; **F**, column; **G**, anther and pollinia. LCDP by M. A. Sierra-Ariza, based on the holotype.

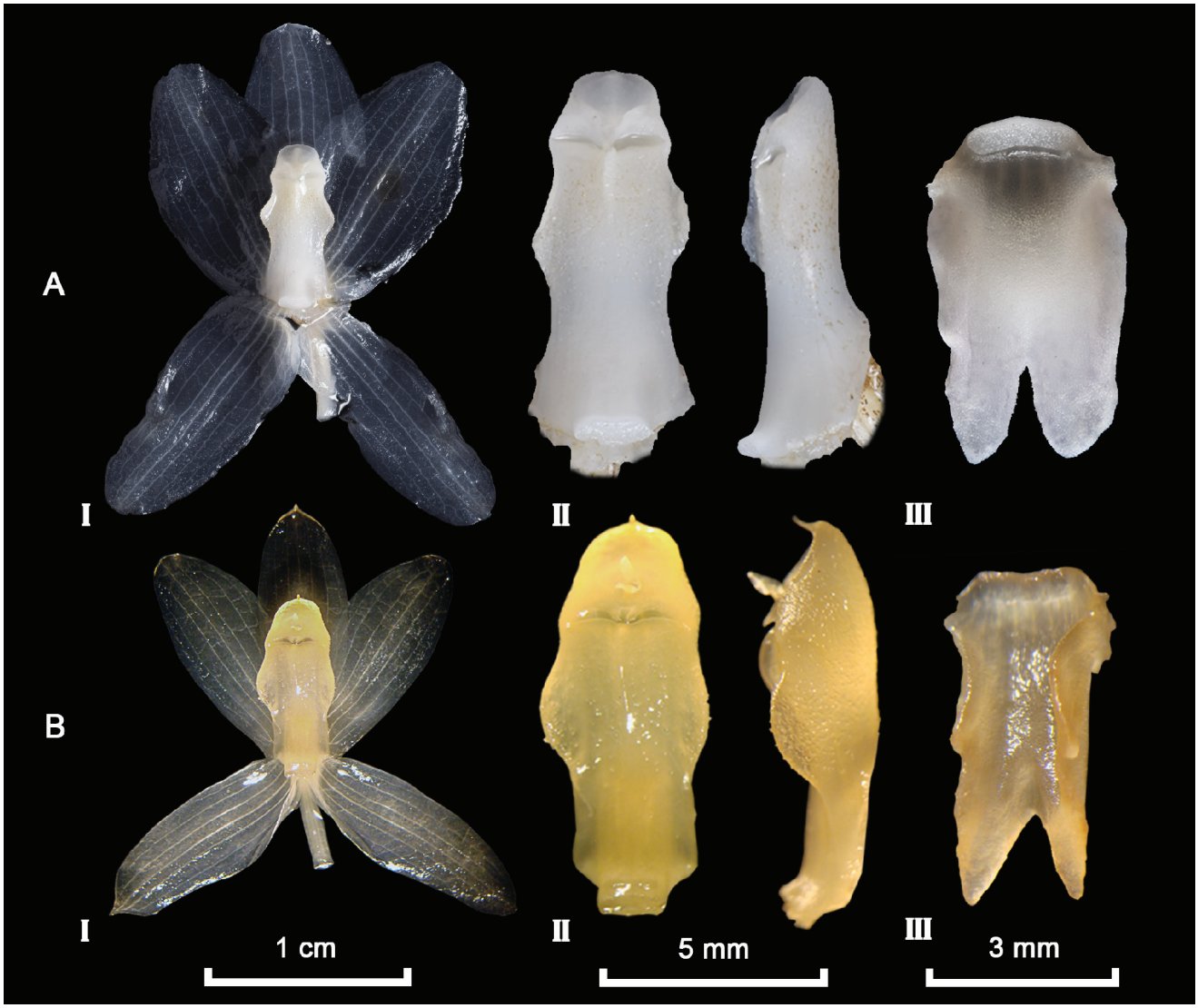


FIGURE 3. Comparison with the most similar species. **A**, *Kefersteinia universitatis-tolimae* Sierra-Ariza; **B**, *Kefersteinia carolorum* Carnevali & Cetzal. **I**, sepals and petals with column; **II**, column; **III**, callus of the lip. Prepared by M. A. Sierra-Ariza. A based on the holotype (TOLI), B on the holotype, *García Esquivel & Bello s.n.* (VEN). Fig. 3B previously published in Carnevali et al., 2015).

*Kefersteinia universitatis-tolimae* Sierra-Ariza and *K. carolorum* Carnevali & Cetzal (Venezuela) share the characteristic of having non-resupinate flowers. However, the new species is distinguished by several distinctive morphological features. Its flowers are slightly larger, with broad petals that have irregularly eroded edges. The lip is suborbicular to slightly unguiculate, and the lip callus has a nearly square shape when viewed from above, with two rounded apical teeth and lacks teeth on the lateral margins. Additionally, its column is slender and scabrous, with smaller and thinner wings. In contrast, *K. carolorum* is characterized by having thin petals with entire margins, an orbicular lip, a slightly pandurate callus with pointed apical teeth and an additional pair of teeth on the lateral margins, a thick and papillose column, and large, wide wings (Fig. 3A vs. 3B).

The flowers of *K. universitatis-tolimae* share similarities with other species of *Kefersteinia*; however, these are characterized by having resupinate flowers. In turn, *K. escalerensis* D.E.Benn. & Christenson (Peru) stands out with its ovate-elliptical petals, a suborbicular lip, and an ovate callus with two sharp and close apical teeth, as well as a thick column with broad wings that bend forward. *Kefersteinia lactea* (Rchb.f.) Schltr. (Mexico to Panama) is characterized by a wide, ovate lip and an ovate callus with pointed teeth, along with a slender column with triangular wings located above the halfway point of its length. *Kefersteinia alba* Schltr. (Costa Rica and Panama) has the distinctive feature of a wide, rhombic to suborbicular lip, accompanied by a lyre-shaped callus and slightly pointed apical teeth, while the column exhibits narrow triangular wings situated above the halfway point of its length. *Kefersteinia microcharis* Schltr. (Costa Rica) has a wide, ovate lip, with an obovate callus when viewed from above, apical teeth that are slightly rounded and separated, and the column lacks wings.

The species *K. sanguinolenta* Rchb.f (found from Venezuela to Bolivia) and *K. klabochii* (Rchb.f.) Schltr. (Colombia) can also potentially lead to confusion with the new species. To address these two species in the current work, an interpretation has been made based on the original descriptions and illustrations provided by Reichenbach f. *Kefersteinia sanguinolenta* has been considered a morphologically variable species with a wide distribution. It is characterized by a cuneate or narrow, obovate lip with strongly undulated margins, a ligulate callus, and column wings that project forward. *Kefersteinia klabochii* is distinguished by its broad, elliptical, transversely-shaped lip, a ligulate callus, pointed apical teeth, and a pair of teeth on the lateral margins.

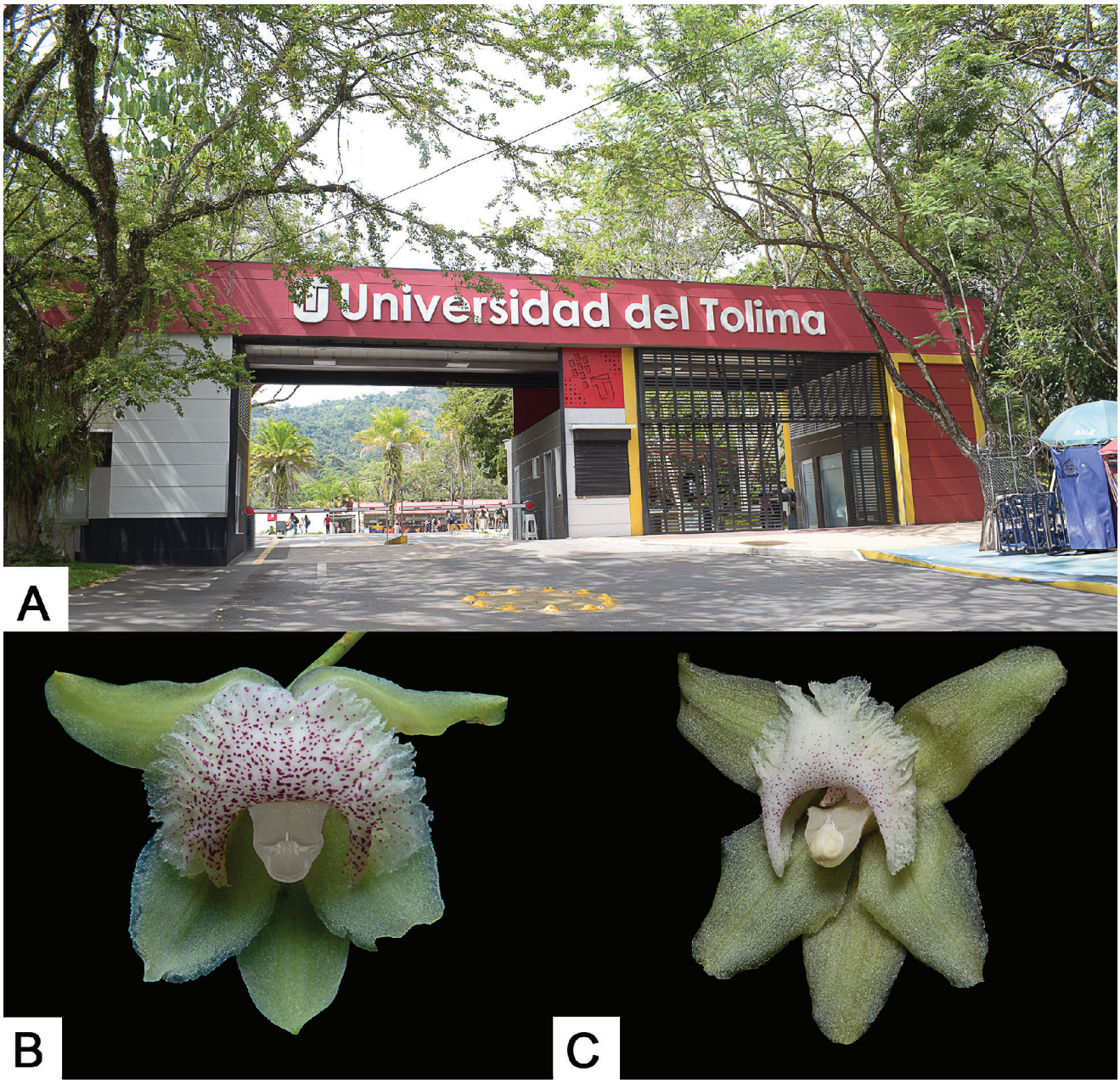


FIGURE 4. **A**, main gate of the University of Tolima; **B**, flowers with a greenish-white hue adorned with numerous scarlet-colored dots; **C**, flowers with a pale white hue adorned with few dots in a claret tone. Prepared by M. A. Sierra-Ariza.

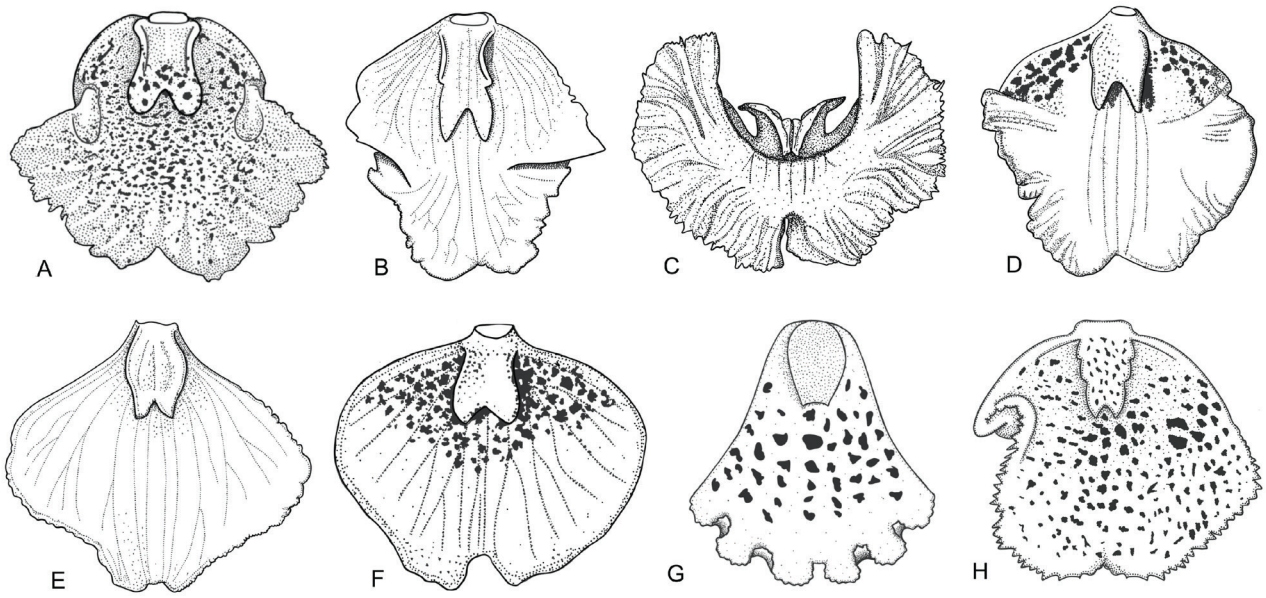


FIGURE 5. Comparison of the adaxial view of the lip of *Kefersteinia* species allied to the new species. **A**, *Kefersteinia universitatis-tolimae* Sierra-Ariza; **B**, *Kefersteinia carolorum* Carnevali & Cetza; **C**, *Kefersteinia escalerensis* D.E.Benn. & Christenson; **D**, *Kefersteinia lactea* (Rchb.f.) Schltr.; **E**, *Kefersteinia alba* Schltr.; **F**, *Kefersteinia microcharis* Schltr.; **G**, *Kefersteinia sanguinolenta* Rchb.f.; **H**, *Kefersteinia klabochii* (Rchb.f.) Schltr. Redrawn by M. A. Sierra-Ariza based on A (holotype, TOLI); B (holotype, VEN); C (holotype, USM); D (*F. Pupulin 2431*, USJ); E (from the lectotype at AMES by F. Pupulin); F (*F. Pupulin 252*, USJ); G (from Xenia Orchid. I, 1854: tab. 25I); H (holotype, W).

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