**Acanthosyris annonagustata** C.Ulloa & P.Jørg. (Santalaceae), newly recorded for the flora of Peru

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**Abstract**

We report *Acanthosyris annonagustata* (Santalaceae) for the flora of Peru, from an Amazon rainforest site in Madre de Dios Department. We describe the species using leaf and fruit morphological traits from field observations and botanical vouchers, and we provide demographic and phenological observations. This is the second verified species of *Acanthosyris* reported from the Peruvian Amazon and the third verified species for Peru. A key for the three species reported in Peru is provided.

**Keywords**

*Acanthosyris*, Santalaceae, Amazon forest, Madre de Dios river basin, range extension, deforestation

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**Introduction**

The genus *Acanthosyris* (Eichler) Griseb. (Santalaceae R. Brown) is represented by six woody taxa with accepted species names (The Plant List 2013; Ulloa et al. 2017). The genus is composed of deciduous to evergreen taxa with alternate leaves, and its habit includes shrubs and small to large trees, often armed with axillary spines. The inflorescence consists of single or several axillary spikes, with drupaceous fruits that are edible in some species (Ulloa and Jorgensen 1998; Nickrent et al. 2010).

*Acanthosyris* has a primarily South American distribution (Der and Nickrent 2008), with habitats including tropical wet, warm temperate, and dry forests. *Acanthosyris glabrate* (Stapf) Stauffer is distributed in the Pacific coastal dry forest of Colombia, Ecuador, and Peru (Ulloa and Jorgensen 1998); *A. falcata* Griseb. is distributed in the Chaco biome of Bolivia, Paraguay, and northern Argentina, and *A. spinascens* (Mart. & Eichl.) Griseb. in the warm temperate forests of southern Brazil, Uruguay, and northeastern Argentina (Nee 1996). *Acanthosyris paule-alvini* G.M. Barroso is endemic to the Atlantic Forest of southern Bahia, Brazil (Barroso 1968; Nee 1996) and *A. asipapote* M. Nee has been reported for the semi-deciduous forest of Santa Cruz, Bolivia (Nee 1996) and the Amazon forest of southern Peru (W3TROPI-COS 2020). *Acanthosyris annonagustata* C.Ulloa & P.Jørg. was originally described in Ecuador, in the Amazon rainforest habitat of Napo, Orellana, and Sucumbios provinces (Ulloa and Jorgensen 1998); more recently its...
distribution has been extended to Costa Rica and Brazil (Morales 2015; Ulloa et al. 2017; GBIF 2019).

Two species of *Acanthosyris* have been previously documented in Peru: *A. glabrata*, based on collections of *Lao* 5153 (MO) and *Vargas* 9 (F, MO) from the Pacific dry forest of Tumbes Department (Ulloa and Jorgensen 1998), and *A. asipapote*, collected in the Amazon forest, in Camisea District, northern Cusco Department (*P. Acevedo* 8950; CUZ, MO, USM).

During a long-term study of forest regeneration dynamics across the Madre de Dios river basin, we collected plant specimens and fruits that were identified as *A. annonagustata*, a species previously not reported from Peru. Here we report the first Peruvian record of *A. annonagustata*, the third verified species of *Acanthosyris* for the flora of Peru, and provide an updated description, images, and demographic and phenological notes for this species. Additionally, we provide a key for the three *Acanthosyris* species reported in Peru.

**Methods**

Plant material was collected from forest plots that were established in 2008–2009 (Swamy 2017; Bagchi et al. 2018), in a private forest reserve known as Reserva Amazónica (Monteagudo et al. 2020), approximately 15 km east from the city of Puerto Maldonado, on the left (northern) bank of the Madre de Dios River. Individuals ≥10 cm diameter at breast height (dbh) were sampled within a 4-ha (200 × 200 m) tree plot, and individuals >1 m tall and <10 cm dbh were additionally sampled within the central 1-ha (100 × 100 m) of the tree plot. Botanical samples for five individuals were collected and have been deposited in the herbarium of Universidad Nacional Mayor de San Marcos (USM) in Lima (*Chama* 8714, 8730, 8895, 8995, 8999). As part of the long-term study, fruit fall has been monitored year-round within the central hectare area of the plot over a 12-year period from 2008–2020; only one individual (with a current dbh of 47.2 cm) has consistently produced fruits over this period.

Our identification was based on vegetative and fruit characters (flowers have not been found to date), following the description and key for woody species of Santalaceae for South America (Nee 1996), with morphological traits of leaves and fruits matching the description of *A. annonagustata* by Ulloa and Jørgensen (1998, 2002). Specimens of *Acanthosyris* at the Aarhus University Herbarium (AAU) and the Universidad San Antonio Abad del Cusco herbarium (CUZ) were reviewed for this study. Our specimens were also compared with images of digital herbaria collections including F, MO, NY, US, and images retrieved from the National Database of Biodiversity of Ecuador (BNDB 2020). Herbaria acronyms follow Thiers (2021).

Maps for the previous records (Fig. 1A) and new record (Fig. 1B) were created using R v. 3.6.3 software (R Core Team 2020) with packages “maps” (Brownrigg 2018) and “sf” (Pebesma 2018) for spatial data, and “ggmap” (Kahle and Wickman 2013) for the map’s visualization.

**Results**

*Acanthosyris annonagustata* C.Ulloa & P.Jørg.

**New records. Voucher.** PERU – Madre de Dios • Tambopata province, permanent tree plot at Inkaterra Reserva Amazonica (Fig. 1B); 12.534°S, 069.053°W; 236 m alt.; 24.X.2014; adult specimens; tree, 33.8 cm dbh; V. Chama 8714 (USM) (Fig. 2A); nucleotide sequence data stored in BOLD (project ID: MDDPE284-17). •
Same collection data as preceding; tree, 35.1 cm dbh; V. Chama 8895 (USM); sequence data stored in BOLD (project ID: MDDPE284-17). • Same collection data as preceding; immature individuals; V. Chama 8730, 8995, 8999 (USM).

Additional material examined. ECUADOR – Napo • Parque Nacional Yasuní, carretera y oleoducto de Maxus en construcción, km 20; 00°33’S, 076°30’W; 250 m a.s.l.; fruit; 28–30.VII. 1993; M. Aulestia & G. Grefa 232 (holotype: QCNE (QCNE727 [image!])); isotype: AAU [not found], GB (GB-0048637 [image!]), MO (MO-288133 [image!]), US (US00603576 [image!]) • Napo: Orellana, Yasuní National Park, road and oil pipeline under construction, km 10–12; 00°29’S, 076°33’W; 250 m alt.; fruit; 10.VII.1993; Tipaz 2724 (paratype: AAU [AAU-Herbarium-G.Tipaz 2724], MO-1744176 [not seen]), QCNE (QCNE85928 [image!]) • Napo: Aguarico cantón, Huaorani Ethnic Reserve, road and oil pipeline under construction, km 67–69; 250 m alt.; flower; 1–3. XII.1993; Aulestia 1318 (paratype: AAU [not found],

Figure 2. Acanthosyris annonagustata C.Ulloa & P.Jørg. A. Leaves disposition of mature individual. B. Leaf above. C. Leaf below and veins. D. Axillary spines (immature individual). E. Matured fruits. F. Endocarp and seed. G. Spine-covered branches from trunk of immature individual (10 cm dbh). H. Close-up of portion of spiny branch. I. Buttresses and bark characters (reproductive individual 47.2 cm dbh).
Differs markedly in A. Fuentes with one or two (Barruso 1968), the two other species were encountered out of 10,845 total individuals. These data indicate that this species is relatively uncommon and likely to be missed in less extensive floral inventory efforts.

Phenology. Over a 12-year period of year-round fruit-fall monitoring in Madre de Dios, Peru (2008–2020), a single reproductive individual (currently 47.2 cm dbh), one of five individuals >10 cm dbh in the tree stand, has fruited in multiple years. The tree appears to fruit primarily in the months of September–January (ca. 80% of all observed fruit), with most fruiting in September (22%), followed by October (17%), December (16%), November (13%), and January (9%).

The genus Acanthosyris is now represented by three species in Peru, which can be separated by the following key:

**Key to Peruvian Acanthosyris**

1a. Leaves ovate.

2a. Fruit ca. 2 cm in diameter; petiole 3–5 mm long; Pacific dry forest, Tumbes Department .......... A. glabrata

2b. Fruit ca. 5.5 cm in diameter; petiole 14–20 mm long; Amazon rainforest, northern Cusco Department .......... A. asipapote

1b. Leaves elliptic; petiole 4–10 mm long; fruit ca. 3 cm in diameter; Amazon rainforest, Madre de Dios Department .......... A. annonagustata

**Discussion**

Based on our record of Acanthosyris annonagustata in the Amazon forest of the Madre de Dios River floodplain, its range is now extended to southeastern Peru (Fig. 1B), 1560 km south from the collections in Ecuador and 540 km south of the collections in Brazil. The distribution of this species may extend to Bolivia, where Acanthosyris specimens with immature fruits have been collected in the tropical forest of Madidi National Park (A. Fuentes et al. 17996, 18026, 18028, 18097B, 18195, 18202, 18274, 18292 (LPB; MO) and Ticona et al. 100 (LPB; MO)); these specimens may correspond to A. annonagustata, pending determination (A. Fuentes pers. comm.). Future extension in the distribution of this species is likely as more subpopulations are expected in other Amazonian areas like the Colombian Amazon (Jørgensen and Pitman 2004).

Acanthosyris annonagustata differs markedly in leaf, petiole, and fruit compared to A. asipapote and A. paulo-alvinii (Barroso 1968), the two other species reported for the wet tropical forest of South America
Morphological features that can be used to distinguish and compare these species are shown in Table 1. In addition to their distinct morphological features, the species have apparently non-overlapping distributions. *Acanthosyris paulo-alvinii* is endemic to the Atlantic forest of Bahia, Brazil, and its conservation status is Critically Endangered (Sambuichi et al. 2008). In Peru, *Acanthosyris asipapote* and *A. annonagustata* have been documented in distinct watersheds within Amazon forests habitats, although *A. asipapote* was previously considered to be restricted to the semi-deciduous forest in Santa Cruz, south Bolivia (Nee 1996; WCME 1998). Based on the IUCN Red List criteria (IUCN 2012), *A. asipapote* is considered to be Vulnerable (WCME 1998) and *A. annonagustata* is Near Threatened (Jørgensen and Pitman 2004), with habitat destruction identified as the main threat.

Among the specimens analyzed, our specimens from Madre de Dios closely match with the specimens of Brazil, Costa Rica, and Ecuador in leaf morphology. However, the Ecuadorian specimens (*Aulestia 232, Villa 1094*) have fruits and seeds that are notably elongate-ellipsoid, whereas fruits and seeds of our specimens are globose, similar to the Brazilian (*Silveira 1065; NY*) and Costa Rican (*Zamora 2938; MO*) specimens. We are aware that floral material, useful for the distinction of species, is currently lacking for our specimens. However, *A. annonagustata* can be rarely misidentified as other *Acanthosyris* species and may be distinguished by the shape and indument of the leaves, length of the petiole, and size of the fruits (Table 1).

Although *A. annonagustata* is known from several collections made in Yasuni National Park in Ecuador (Ulloa and Jørgensen 1998, 2002; Jørgensen and Pitman 2004), its low population density might explain why the species has not been previously collected in Peru and missed in previous botanical inventories conducted in the Madre de Dios region (e.g., Gentry and Ortiz 1993; Valenzuela et al. 2007; Dueñas and Garate 2008; Montagudo et al. 2020). In fact, in three large-scale tree inventories in the Yasuni National Park, only 21 individuals were recorded in a 200,000-tree sample, <0.01% of all stems (Jørgensen and Pitman 2004). This is even lower than the density found in our tree inventory, where four individuals out of 2061 total individuals (<0.2% of all stems) were recorded.

The area surrounding our collection site is exposed to intense hunting and deforestation by small-scale agriculture (Bagchi et al. 2018), which could have a bearing on the conservation status of this species, given that it has not yet been recorded anywhere else in the basin or elsewhere in Peru. Overall, *Acanthosyris* remains a poorly studied taxonomic group (Ulloa and Jørgensen 2002) and more research is necessary to understand its distribution, diversity, and conservation status in South America.

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**Authors’ Contributions**

JPLF reviewed herbarium specimens, collected, and identified part of the material, and wrote the manuscript; VS photographed and collected some of the material, and contributed to writing the manuscript. Both authors designed the study and established the inventory plots for the long-term study.

**References**


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Table 1. Morphological characteristics for *Acanthosyris* species reported in tropical forests of South America.

<table>
<thead>
<tr>
<th>Species</th>
<th>Leaf shape</th>
<th>Leaf indument</th>
<th>Petiole length (mm)</th>
<th>Fruit diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>A. annonagustata</em></td>
<td>Elliptic</td>
<td>Glabrous and lustrious</td>
<td>4–9(10)</td>
<td>2.1–3.2</td>
</tr>
<tr>
<td><em>A. asipapote</em></td>
<td>Ovate</td>
<td>Glabrate except midrib abaxial</td>
<td>14–20</td>
<td>5.5</td>
</tr>
<tr>
<td><em>A. paulo-alvinii</em></td>
<td>Obtuse-lanceolate</td>
<td>Glabrous</td>
<td>20–30</td>
<td>6.0–8.0</td>
</tr>
</tbody>
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