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Mapping knowledge on Arbuscular Mycorrhizal Fungi in the Amazon rainforest: a systematic review of diversity, distribution and symbiotic interactions

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ABSTRACT

The Amazon rainforest is one of the main global biodiversity hotspots where its diverse plant community provides optimal conditions and habitats for several soil microorganisms. Among these, Arbuscular Mycorrhizal Fungi (AMF) establishes important symbiotic relationships with many species of plants. We carried out a systematic bibliometric review of AMF in the Amazon, the mycorrhizal status of plant species, and a detailed analysis of the distribution of studies and occurrences of AMF species in Amazonian countries. The 110 studies examined had substantial spatial disparity, with research initiatives clustered in particular regions of Brazil and Peru, while information was totally absent for many Amazonian regions, including some countries in their entirety. The compiled studies encompassed 164 sampling sites in only 22 of the 55 Amazonian ecoregions. Furthermore, our analysis identified that most research focus was on assessing root colonization, morphological diversity, and spore quantification. These studies documented 143 AMF species, with the family Acaulosporaceae being most prevalent, and we highlight the description of 12 new species and four new genera from the Amazon. Only 181 plant species in 55 families were evaluated for symbiotic potential, of which 49 species (most in the Lecythidaceae) had no mycorrhizal association. This review underscores the necessity for expanded geographical coverage in inventories of Arbuscular Mycorrhizal Fungi, implementation of molecular approaches to expedite diversity assessment, and increased focus on plant-fungal symbiotic interactions throughout the Amazon.

KEYWORDS: Amazonian ecosystems, AMF diversity, bibliometric review, Glomeromycota, mycorrhizal symbiosis

Mapeando o conhecimento sobre Fungos Micorrízicos Arbusculares na floresta amazônica: uma revisão sistemática da diversidade, distribuição e interações simbióticas

RESUMO

A Floresta Amazônica é um dos principais *hotspots* globais de biodiversidade, onde sua diversificada comunidade vegetal proporciona condições e habitats ideais para diversos microrganismos do solo. Entre eles, os Fungos Micorrízicos Arbusculares (FMA) estabelecem importantes relações simbióticas com a maioria das espécies de plantas. Nós conduzimos uma revisão bibliométrica sistemática sobre os principais tópicos de pesquisa em FMA na Amazônia, o status micorrízico das espécies vegetais e uma análise detalhada da distribuição dos estudos e da ocorrência de espécies de FMA nos países amazônicos. Os 110 estudos avaliados tiveram substancial disparidade espacial, com iniciativas de pesquisa predominantemente concentradas em regiões específicas do Brasil e do Peru, enquanto uma ausência completa de dados foi observada em muitos territórios amazônicos, incluindo alguns países em sua totalidade. Os estudos compilados abrangeram 164 locais de amostragem distribuídos em apenas 22 das 55 ecorregiões amazônicas. Além disso, nossa análise identificou um foco predominante de pesquisa na avaliação da colonização radicular, diversidade morfológica e quantificação de esporos. Estes estudos documentaram 143 espécies de FMA, com Acaulosporaceae sendo a família predominante, e destacamos a descrição de 12 novas espécies e quatro novos gêneros a partir de solos amazônicos. Apenas 181 espécies de plantas de 55 famílias foram avaliadas quanto ao potencial simbiótico, das quais 49 espécies (a maioria em Lecythidaceae) não apresentaram colonização micorrízica. Esta revisão ressalta a necessidade de ampliar a cobertura geográfica nos inventários de Fungos Micorrízicos Arbusculares, implementar abordagens moleculares para agilizar a avaliação da diversidade e aumentar o foco nas interações simbióticas entre plantas e fungos em toda a Amazônia.

PALAVRAS-CHAVE: Ecossistemas amazônicos, diversidade de FMA, revisão bibliométrica, Glomeromycota, simbiose micorrízica

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INTRODUCTION

The Amazon is the largest tropical rainforest on the planet, covering over 6 million km^2 of South America and spanning nine countries: Brazil, Peru, Colombia, Venezuela, Bolivia, Ecuador, Guyana, Suriname, and French Guiana, with 60% of its total area in Brazil (RAISG 2015; Albert *et al.* 2021). Its extensive territory encompasses a highly diverse landscape, where vegetation patterns are primarily determined by climate and further influenced by soil, topography, and hydrology. These vary from savannas to dry and wet forests; from permanently to seasonally flooded or never flooded (terra-firme); from open campinas and campinaranas on poor white-sands to dense terra-firme forest on clay soils (IBGE 2004).

In addition, according to global terrestrial ecosystem frameworks (Olson *et al.* 2001; Dinerstein *et al.* 2017), the Amazon is divided into multiple ecoregions, large land units defined by distinctive combinations of environmental conditions, vegetation physiognomies, and associated biological communities. This heterogeneity sustains the greatest biodiversity on Earth and provides genetic resources and ecological services essential for the maintenance of several ecosystems around the world (Strand *et al.* 2018).

A taxonomically verified species list indicates that more than 14,000 plant species are found in the Amazon, while some estimates suggest as many as 50,000 (Cardoso *et al.* 2017). This plant diversity contributes to a complex belowground environment that supports rich and diverse microbial communities, including root-associated symbionts (Chen *et al.* 2019; Edy *et al.* 2022). Additionally, although Amazonian soils are highly heterogeneous, reflecting diverse geological origins and pedogenetic stages, vast areas, particularly in the central and eastern Amazon, are dominated by highly weathered and nutrient-poor soils (Quesada *et al.* 2010, 2011) that favor the establishment of arbuscular mycorrhizal fungi (AMF), which play a key role in plant nutrient acquisition.

Arbuscular Mycorrhizal Fungi are the most abundant and crucial fungi for meeting the phosphorus (P) requirements of plants, a key nutrient regulating forest dynamics in the Amazon (Reichert *et al.* 2022). Phosphorus is mobilized by AMF directly through their extensive extraradical hyphae and may also interact with phosphate-solubilizing bacteria. AMF also facilitate nitrogen (N) uptake in the forms of ammonium, nitrate, and amino acids, promoting indirect organic matter mineralization by priming effect, and enhances the absorption of low-mobility trace elements (i.e., K, Ca, Mg, Cu, Zn, Fe, and Mn) in soils (Fall *et al.* 2022; Wu *et al.* 2024). Structurally, extraradical mycelia promote soil aggregation through physical entanglement and glomalin production, which increases water infiltration, reduces erosion, and improves the retention of nutrients (Demenois *et al.* 2018; Morris *et al.* 2019). In addition, AMF contribute to host resilience by providing protection against pathogens and mitigating abiotic stresses, such as drought, salinity, and heavy metal toxicity (Wahab *et al.* 2023). In return, AMF receive photosynthetically fixed carbon provided mainly as carbohydrates and lipids from their host plants (Jiang *et al.* 2017; Hammer *et al.* 2024).

Approximately 370 AMF species have been formally described (Hyde *et al.* 2024), along with many potentially new taxa identified by environmental DNA sequencing (Tedersoo *et al.* 2024). AMF occur across all climatic zones and ecosystems around the world (Davison *et al.* 2015), forming symbiotic relationships with about 72% of terrestrial plants (Brundrett and Tedersoo 2018). Nonetheless, the global distribution of AMF studies is heterogeneous and severely constrained by spatial bias and sampling effort, particularly in tropical forests where AMF diversity is presumably high (Stürmer *et al.* 2018; Stewart *et al.* 2025; Van Nuland *et al.* 2025).

Compilations of AMF species have revealed a large species diversity in the Amazon. Winagraski *et al.* (2019) compiled data on AMF diversity in Brazilian forest ecosystems and reported 132 species in the Amazon; however, the authors included taxa that were not confirmed at the species level. Maia *et al.* (2020) compiled records of AMF occurrence across all Brazilian floristic domains and reported 94 species in the Brazilian Amazon, highlighting it as the least studied biome in this country. Vega-Herrera *et al.* (2022) reported 84 species in the Peruvian Amazon. Peña-Venegas *et al.* (2022) documented approximately 50 species in the Colombian Amazon. In a more comprehensive review of AMF diversity in South America, Cofré *et al.* (2019) provided a list of > 100 species occurring in the Amazon. Although these studies compiled relevant information and expanded the availability of data on AMF in the Amazon, their approaches reflected country-specific contexts and mostly prioritized only AMF species inventories. No efforts have yet been made to integrate this knowledge into a broader, cross-border perspective that systematically considers ecology and methodology.

In this study, we carried out a systematic bibliometric review of AMF across the entire extent of the Amazon, to provide information on (i) the distribution of studies, (ii) the richness and distribution of AMF species, (iii) the main methodological approaches used in the studies, (iv) the mycorrhizal status of plant species, and (v) the significant gaps in existing research, guiding future investigations towards under-studied areas and advancements in new research topics.

METHODS

We searched extensively in the Web of Science, Scopus and Scielo databases using keywords associated with AMF and Amazon. The search was filtered by the fields "title", "abstract" and "keywords" and covered the period from January 1945 to December 2024. The keywords were used in four languages (English, Portuguese, Spanish, and French), the official languages of the countries within the Amazon domain. The search string used was as follows: (“Arbuscular Mycorrhizal Fungi” OR “Arbuscular mycorrhiza” or “Vesicular arbuscular mycorrhiza” OR “AM fungi” OR “Fungos Micorrízicos Arbusculares” OR “Micorriza arbuscular” OR “fungos micorrízicos vesículo arbusculares” OR “Hongos Micorrízicos Arbusculares” OR “Hongos Micorrízicos Vesículo Arbusculares” OR “Champignons mycorhiziens arbusculaires” OR “Mycorhize arbusculaire” OR “mycorhizes vésiculaires–arbusculaires” OR “Glomeromycota” OR “Glomeromycotina”) AND (“Amazon” OR “Amazonian” OR “Amazônia” OR “Amazônica” OR “Amazônico” OR “Amazonía” OR “Amazónica” OR “Amazónico” OR “Amazonie” OR “Amazonienne” OR “Amazonien”). In addition, a simplified search using pairs of aforementioned keywords was used in Google Scholar with the aim of identifying additional articles not included in the previously mentioned databases. Gray literature, including theses and dissertations, was not considered for the analysis due to the lack of centralized indexing, which hinders data retrieval from multiple national repositories across Amazonian countries, and the lack of standardized peer-reviewed formats.

We analyzed all articles for information on the country of study, plant and AMF species contained in those studies, and on methodology. Regarding methodology, studies were classified based on the type of data or analyses performed, i.e., assessments of root colonization, evaluation of AMF diversity through spore morphological identification or environmental DNA sequencing, quantification of soil spore density, glomalin content analysis, inoculation experiments, taxonomic description of new species, and less frequently approaches grouped as “others”. Graphs to represent this information were made with R software version 4.3.1 (R Core Team 2023). Two maps were built to illustrate the distribution of the studies: the first is their geographic distribution by country, and the second their occurrence within ecoregions. Both maps were produced in QGIS 3.31.36, using shapefiles from the Instituto Brasileiro de Geografia e Estatística (IBGE), the DATABASIN and the RESOLVE Ecoregions dataset (*https://ecoregions.appspot.com/*). For records lacking precise geographical coordinates, nearby localities were used as proxies. A checklist of AMF species occurrences for each country was compiled, and the species classification was updated following Hyde *et al.* (2024) and da Silva *et al.* (2024, 2025). Records without identification at the species level were not included. Species names of fungi, and their authors, are in accordance with the Mycobank database.

RESULTS

After filtering the search results to exclude studies that did not align with the purpose of this review, 110 articles were selected and analyzed (Table S1). The distribution of studies across the countries reflects, in part, the territorial extent of each nation within the Amazonian region (Figure 1). Brazil, which encompasses the largest portion of the Amazon, accounts for the most publications (60), followed by Peru (32), Colombia (9), Ecuador (4), and French Guiana (3). Meanwhile, Bolivia and Venezuela have only one study each in their Amazonian regions, and Guyana and Suriname had no published studies identified. This distribution also reveals an unequal focus within each country. In Brazil, for instance, the majority of studies are concentrated in the state of Amazonas, particularly around Manaus, while in Peru, most studies are concentrated in the San Martin region (Figure 1).

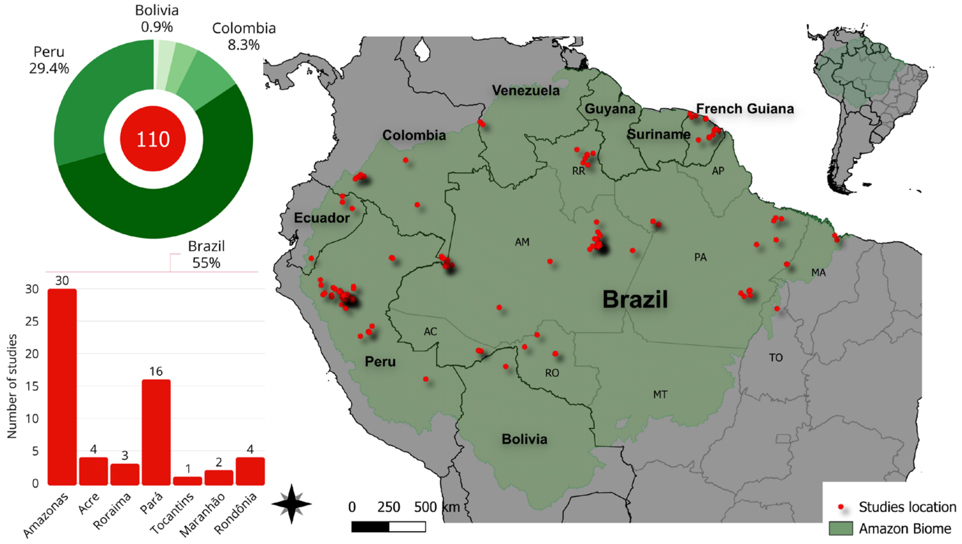

Figure 1. Geographic distribution of studies on AMF in countries, and Brazilian states, in the Amazon domain. Red dots may overlap when multiple studies were at the same location. When a single study evaluated two or more localities, each locality was plotted independently.

When considering AMF studies by ecoregion, only 22 of the 55 ecoregions of the Amazonian domain (Olson *et al.* 2001; Dinerstein *et al.* 2017) were included (Figure 2a). Altogether, the 110 studies encompassed 164 sampling sites, but the research efforts were uneven and focused in few ecoregions. The Ucayali Moist Forests (Figure 2b) contained the largest number of sampling sites (28), followed by the Uatumã–Trombetas Moist Forests (19) (Figure 2d, i) and the Peruvian Yungas (18) (Figure 2b). Together, these three ecoregions accounted for nearly 40% of all sampling locations, with two (Ucayali Moist Forests and Peruvian Yungas) entirely within Peru (Figure 2b).

A total of 143 AMF species were detected in the Amazon, in 17 families and 34 genera (Table S2). The most represented family is Acaulosporaceae (36 spp.), followed by Glomeraceae (20 spp.) and Sclerocystaceae (13 spp.) (Figure 3c). Among these, 12 new species, including four new genera, were originally described based on material collected in the Amazon: *Acaulospora endographis* (Goto *et al.* 2013), *Sclerocarpum amazonicum* (Jobim *et al.* 2019), *Acaulospora aspera* (Corazon-Guivin *et al.* 2019a), *Funneliglomus sanmartinensis* (Corazon-Guivin *et al.* 2019b), *Microkamienskia peruviana* (Corazon-Guivin *et al.* 2019c), *Nanoglomus plukenetiae* (Corazon-Guivin *et al.* 2019d), *Rhizoglomus variabile* (Song *et al.* 2019), *Paraglomus occidentale* (Corazon-Guivin *et al.* 2020), *Acaulospora flava* (Corazon-Guivin *et al.* 2021), *Paraglomus peruvianum* (Lebeuf *et al.* 2022), *Acaulospora flavopapillosa* (Corazon-Guivin *et al.* 2022a), and *Rhizoglomus cacao* (Corazon-Guivin *et al.* 2022b).

Consistent with many studies in these countries, Brazil and Peru had higher species richness. In Brazil, 105 species were recorded, followed by Peru (74), Colombia (26), and Ecuador (5) (Figure 3a,b). In French Guiana, three molecular studies have been conducted. One detected AMF sequences exclusively within Glomeraceae, with no species-level identification, although the data suggest potential new

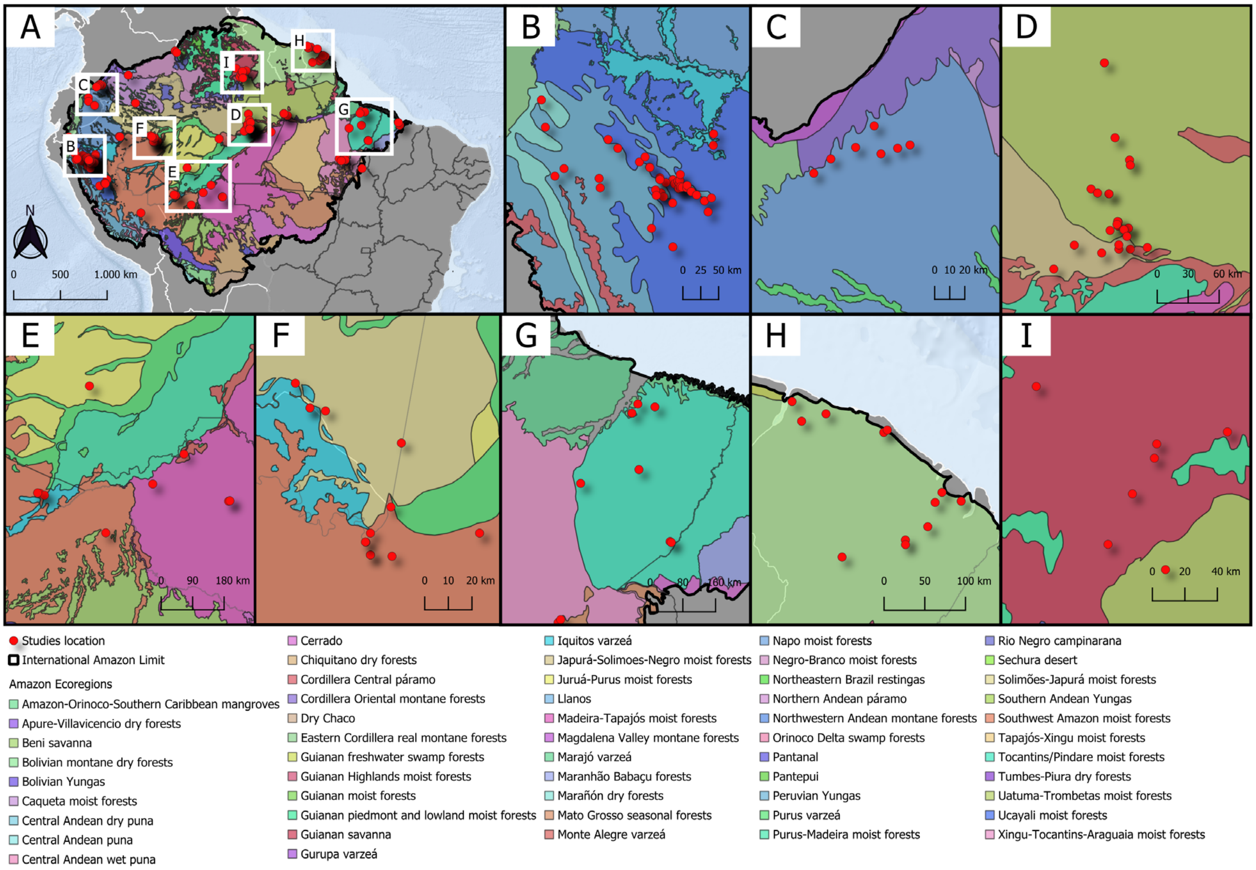

Figure 2. Geographic distribution of studies on AMF across ecoregions within the Amazon domain, grouped following Olson *et al.* (2001) and Dinerstein *et al.* (2017). (**A**) Overview of all study sites across Amazon ecoregions. (B-I) Details indicating better-sampled locations. Isolated points are not shown to emphasize the main sampling areas within the ecoregions. (**B**) Ucayali Moist Forest and Peruvian Yungas, Peru. (**C**) Napo Moist Forest, Colombia. (**D**) Uatuma-Trombetas and Japurá-Solimões-Negro Moist Forests in Amazonas, Brazil. (**E**) Southwest Amazon Moist Forest in Acre, Brazil; Madeira-Tapajós Moist Forests and Monte Alegre Varzeá in Rondônia, Brazil; and Southwest Amazon Moist Forest, Bolivia. (**F**) Southwest Amazon Moist Forest in Amazonas, Brazil; Iquitos Varzeá and Solimões-Japurá Moist Forests, Colombia. (**G**) Tocantins/Pindaré Moist Forests in Pará, Brazil. (**H**) Guianan Moist Forests, Guyane. (**I**) Guianan Savanna and Uatuma-Trombetas Moist Forests in Roraima, Brazil.

taxa (Brearley *et al.* 2016). Another quantified soil AMF biomass without assessing community composition (Soong *et al.* 2020), and a third reported Glomeromycota only at the phylum level (Boisseaux *et al.* 2024). In the Amazonian regions of Venezuela, Guyana, Suriname, and Bolivia, no specific AMF diversity studies were found.

The most-reported species in the Amazon were *Acaulospora foveata* (25 records), *A. mellea* (24), *A. tuberculata* (23), and *Entrophospora etunicata* (22) (Table S2). Overall, in addition to its high species richness, *Acaulospora* also was most geographically widespread in the Amazon region, with at least eight species having more than 10 occurrence records each, predominantly in the Brazilian and Peruvian Amazon (Figure 3c). Species from other genera also had notable distributions across the Amazon. For instance, *Rhizoglomus clarum* and *Ambispora leptoticha* were recorded 18 and 15 times, respectively, predominantly in Brazil and Colombia. *Glomus macrocarpum* (15) and *Funneliformis geosporum* (13) were also frequently identified in Brazil and Peru (Table S2).

The most common methodologies used in those studies included root colonization assessments, diversity inventories with species identification based on spore morphology, and soil-spore quantification (Figure 4). Many of the studies also focused on inoculation experiments, which utilized either prepared inocula or native soils as sources of AMF. These experiments examined the efficacy of AMF isolates in promoting growth and health of associated plant species with considerable economic and ecological importance in the Amazon region. For instance, inoculation with *Rhizoglomus aggregatum* increased leaf phosphorus concentration and dry matter accumulation in pejibaye palms (Clement and Habte 1995). In *Schizolobium amazonicum*, a fast-growing Amazonian tree commercially valuable for wood production, interaction among N-fixing bacteria and *R. clarum*, *R. intraradices* and *Entrophospora etunicata* enhanced plant growth, biomass, and wood production (Siviero *et al.* 2008), while native isolates of *E. etunicata* and *Acaulospora* sp. also improved wood productivity in *Schizolobium parahyba* (Cely *et al.* 2016). In *Vigna unguiculata*, a wide range of native isolates increased its phosphorus uptake and growth, with *A. foveata*, *Glomus* sp.1, and *E. infrequens* among the most efficient (Silva *et al.*

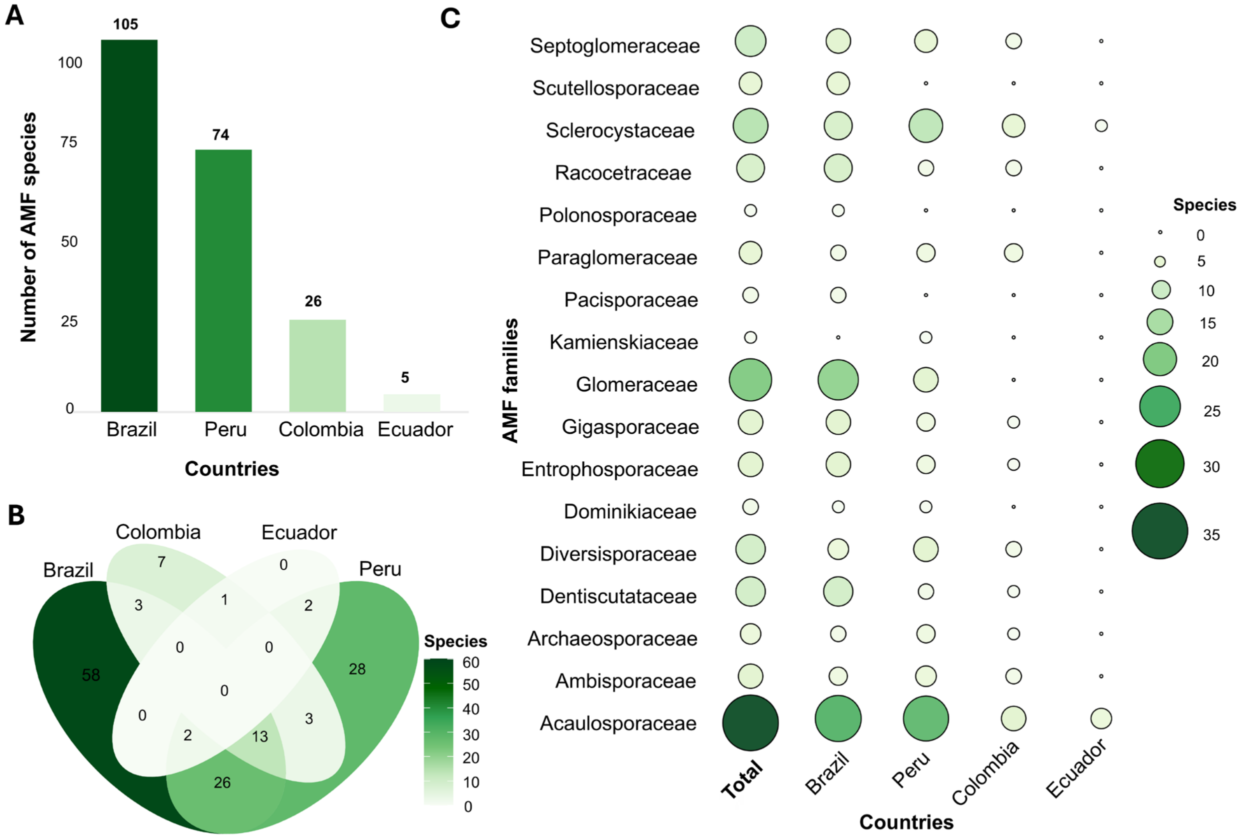

Figure 3. Overview of AMF diversity across Amazonian countries. (**A**) Total number of AMF species reported by country. (**B**) Venn diagram illustrating the overlap of AMF species among countries. (**C**) Species richness of AMF families recorded by country.

2009). In *Piper aduncum*, inoculation with *R. clarum* and *E. etunicata* altered secondary metabolite production (de Oliveira *et al*. 2019). In coffee, field soil inocula improved plant height and branching (Vallejos-Torres *et al*. 2019), while inoculation with *R. variabile* and *Nanoglomus plukenetiae* enhanced shoot, root, and total biomass (Corazon-Guivin *et al*. 2023).

Additionally, some diversity studies employed metabarcoding, enabling fungal community characterization through environmental sequencing. Most of these focused on environmental sequencing of fungi, within which AMF were detected, although identification was often limited to Glomeromycota *incertae sedis*. Only eight studies specifically targeted AMF, allowing for the identification of environmental sequences at genus or species level (Brearley *et al*. 2016; Garcés-Ruiz *et al*. 2017; Peña-Venegas *et al*. 2019, 2021; Rodríguez-León *et al*. 2021; Arévalo-Granda *et al*. 2023; Braga *et al*. 2023; Pineda-Lázaro *et al*. 2024).

Multiple methodological approaches were frequently employed within individual studies. Chord diagram analysis (Figure 4) revealed co-occurrence patterns among different methodologies. The strongest co-occurrence was observed between inoculation and colonization studies, followed by colonization paired with morphological diversity inventories. Additionally, sporulation analysis demonstrated strong co-occurrence with both colonization assessments and morphological diversity studies.

The symbiotic profile of 181 plant species from 55 families were examined (Table S3, Figure 5), including native Amazonian species and cultivated crops. Of the total, two species were pteridophytes, one species a gymnosperm, while 178 are angiosperms, comprising 23 monocotyledons and 155 eudicotyledons. Families with the most studied species were Lecythidaceae (33) and Fabaceae (27). The majority of species were colonized by AMF, while 49 showed no evidence of mycorrhizal colonization. Most of these belong to Lecythidaceae, including 30 species that had only weakly attached hyphae on the roots, which led the authors to classify them as likely non-mycorrhizal (Moreira *et al*. 1997). Although studies have investigated areas dominated by other plant species, they did not directly assess the plants' mycorrhizal status, i.e., the presence of fungi within the roots, focusing only on the soil of the rhizosphere.

DISCUSSION

Surprisingly, few studies (110) in fewer than half of the ecoregions (22 of 55) of the Amazon indicate an important gap in understanding Arbuscular Mycorrhizal Fungi (AMF). This gap is even more important when we consider the omnipresence of AMF associated with Amazonian (and other) plants. Despite the largest territorial extent of the Amazon being in Brazil, the Amazon remains the least-studied Brazilian biome for AMF diversity, with only 10 inventories that identified 97 species (Maia *et al*. 2020). Meanwhile, smaller

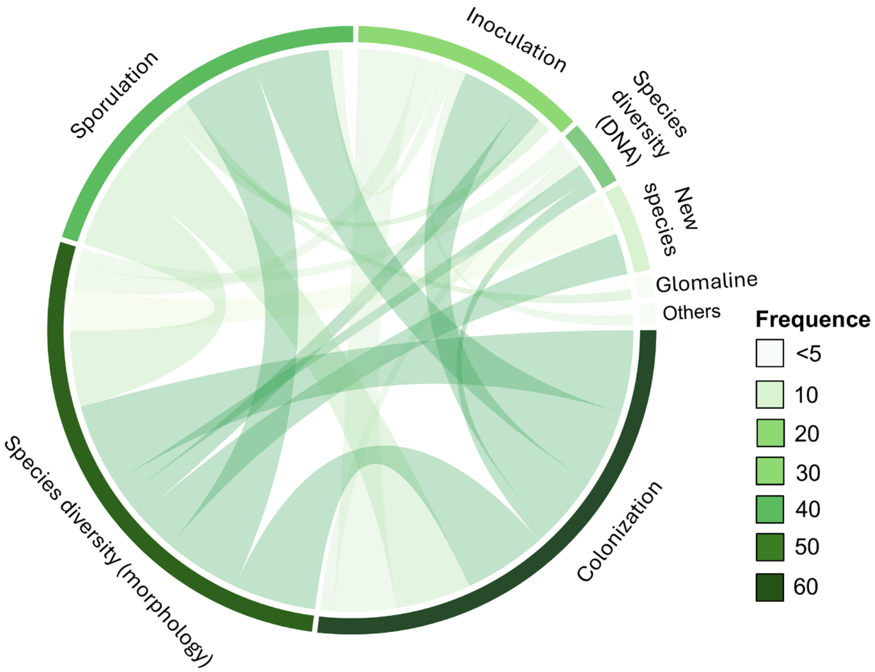

Figure 4. Frequency and co-occurrence of methodologies used in AMF studies in the Amazon. Segments show approaches colored by frequency (number of articles). Connections indicate co-occurrences (>2) between methods in the same studies.

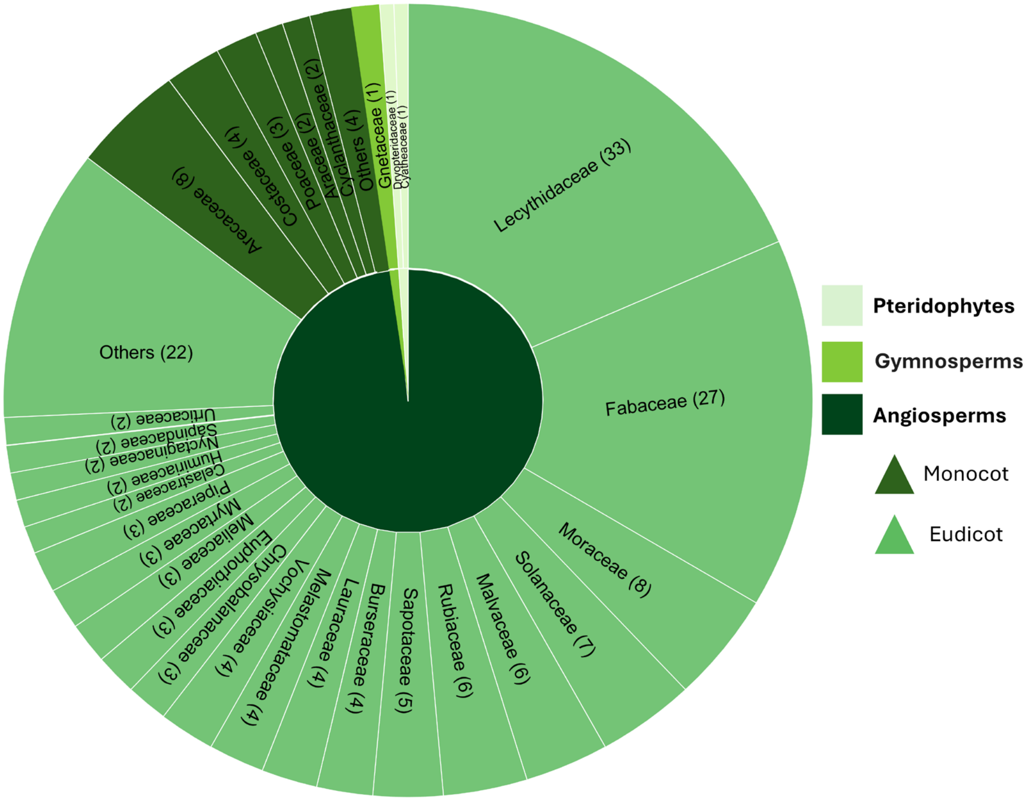

Figure 5. Plant families studied for their symbiotic potential to form arbuscular mycorrhizal associations in the Amazon. Numbers in parentheses indicate the number of species investigated per family. Within Eudicotyledons and Monocotyledons, the category "Others" groups families represented by only one species reported in this review.

biomes are more comprehensively inventoried, such as the Atlantic Forest (153 species in 23 surveys), Cerrado (140 in 16), and Caatinga (120 in 14). Despite the fewer studies, more than 50% of all AMF species identified in Brazil were found in the Amazon (Maia *et al.* 2020 and updated in this review).

Most AMF studies in the Brazilian Amazon were in the state of Amazonas (AM), particularly near Manaus and the Instituto Nacional de Pesquisas da Amazônia (INPA), an important research center that provides crucial infrastructure and logistical support for sample collection and processing compared to more remote regions. In contrast, Brazilian states including Mato Grosso (MT) and Amapá (AP) remain completely unstudied (Figure 1). Leite-Júnior *et al.* (2022) reviewed fungi in the Mato Grosso portion of the Amazon and showed that data are scarce and some groups, such as AMF, have never been investigated.

The absence of studies in these regions is particularly alarming given the ongoing environmental degradation throughout the Brazilian Amazon. According to the most recent MapBiomas report (2024), the conversion of pristine ecosystems into agriculture and mining are the main drivers of deforestation. As a result, the Amazon biome alone accounted for 25% of the total deforestation of Brazil in 2023, with almost 5,000 km² of native vegetation lost. The states of Pará (1,665.8 km²), Mato Grosso (974.1 km²), and Amazonas (877.6 km²) lost the largest areas to deforestation. In Mato Grosso specifically, protected areas are facing critical threats, with a particularly urgent case proposal to revoke the protected status of Cristalino II State Park, recognized as the most biodiverse conservation unit in southern Amazonia, due to recent, illegitimate, land claims (Rodrigues *et al.* 2025).

The 164 sampling sites compiled in this study encompass only 22 of the 55 ecoregions recognized in the Amazon. This restricted coverage mirrors the global scenario where among the 848 terrestrial ecoregions, 73% remain completely unsampled for AMF in the largest dataset of AMF environmental DNA sequences (Stewart *et al.* 2025). This undersampling applies to many tropical forests, and even among the sampled ecoregions, representation is low, with an average of fewer than five samples per ecoregion. Expanding research efforts to the remaining 60% of Amazonian ecoregions is essential for obtaining a more comprehensive understanding of AMF and should encompass not only species distributions but also associations, which are crucial for understanding the roles of AMF in ecosystems as well as to guide conservation efforts.

Additionally, the geographic concentration of researchers specializing in specific topics is an important source of spatial bias in AMF studies, as in Peru, where most AMF research is in the San Martín region. This concentration is probably the consequence of the Universidad Nacional de San Martín, with scientists working on AMF ecology and taxonomy, and whose efforts resulted in the description of new AMF species from the Amazon (Corazon-Guivin *et al.* 2019a, b, c, d; 2020; 2021; 2022a, b; Song *et al.* 2019; Lebeuf *et al.* 2022).

With the data we compiled in this review we showed more than 140 AMF species in the Amazon, in 17 families of the known 22 (77%) and 34 genera of the known 52 (65%) within Glomeromycota (da Silva *et al.* 2024, 2025; Goto *et al.* 2024; Błaszkowski *et al.* 2025a, b), likely represent important underestimates of the associations that exist in the Amazon. While species richness is substantial, coupled with the description of new taxa, including 12 species and four new genera, the limited scope of investigations conducted to date, highlights the remarkable potential of the Amazon as a reservoir for even greater undiscovered AMF diversity.

The Acaulosporaceae, represented by the genus *Acaulospora*, had the highest species richness (36 spp.), with more than 50% of all its reported species. *Acaulospora* has a cosmopolitan distribution and tolerates numerous stressful environmental conditions, usually producing copious spores (da Silva *et al.* 2022). The high richness and number of occurrences in the Amazon, mainly in Brazil and Peru, corroborate previous checklists that identified this genus as the most widely distributed in Brazilian biomes (Maia *et al.* 2020) and as having the highest richness throughout the Peruvian Amazon (Vega-Herrera *et al.* 2022).

While we found greater species richness of Acaulosporaceae, this was due to morphological spore identification, while molecular identification consistently shows that Glomeraceae and Sclerocystaceae are dominant, particularly the genera *Glomus* and *Rhizoglomus*, in root and soil DNA samples from the Amazon (Peña-Venegas *et al.* 2019, 2021; Rodríguez-León *et al.* 2021). AMF species have different life strategies and may be differentially detected depending on the methodology employed. Morphological approaches are particularly effective for identifying spore-producing species, although spore production can be influenced by biotic and abiotic factors, while molecular techniques, capable of capturing DNA from both spores and mycelium, can be more suited for detecting species that predominantly invest in mycelial networks (Öpik *et al.* 2014). Therefore, integrating both methods is essential for obtaining a comprehensive and accurate assessment of AMF diversity.

Gaps in information about AMF biogeography are also a consequence of the challenges of AMF taxonomy (Goto *et al.* 2024). In the Amazon, most studies rely only on morphological identification, leading to an underrepresentation because of (i) ambiguity due to spore quality when obtained directly from field soil samples, and (ii) the limited characters used for spore identification. Environmental sequencing approaches, such as Next-Generation Sequencing (NGS) and Single Molecule Real Time sequencing (SMRT, Pacific Biosciences), are important complementary tools for accelerating diversity documentation in inventories (Öpik *et al.* 2014; Kolaříková *et al.* 2021). The former has gained remarkable attention for characterizing AMF communities, with an expanding repository of environmental sequences (many of which belong to undescribed lineages) available in public databases that reveal novel taxa even at the family or order level (Tedersoo *et al.* 2024). However, only a limited number of studies employing NGS have been conducted in the Amazon, most of which focused on general fungal communities using low resolution (and which can miss the Glomeromycota) universal primer sets targeting the internal transcribed spacer (ITS) (Mueller *et al.* 2014; 2016a; Cerqueira *et al.* 2018; Soong *et al.* 2020; Vasco-Palacios *et al.* 2020; Boisseaux *et al.* 2024). More specific molecular strategies have been developed to improve detection of this group. The 18S rRNA gene (small subunit, SSU) has been widely used in AMF community studies, especially with primer pairs such as AML and WANDA (Lee *et al.* 2008; Dumbrell *et al.* 2011; Bukovská *et al.* 2021). Nevertheless, SSU marker have limited resolution for closely related species. Alternatively, the 28S rRNA gene (large subunit, LSU), especially its hypervariable D2 domain, improved resolution at the genus and species levels and is becoming increasingly used in AMF community studies (Mueller *et al.* 2016b; Delavaux *et al.* 2022; Malicka *et al.* 2022). These markers, along with more targeted sequencing techniques, are promising tools for future studies to accurately measure AMF diversity in Amazonian ecosystems.

Amazonian biodiversity is estimated at over 50,000 plant species, of which only 14,000 have been formally catalogued (Cardoso *et al.* 2017). Our survey revealed a significant gap in knowledge about mycorrhizal associations in this biome, as only 181 species (less than 2% of the catalogued flora) have been investigated for their symbiotic interactions with AMF. This deficit is particularly notable considering the importance of fungi associations (Brundrett and Tedersoo 2018). It is important to mention that colonization studies have predominantly focused on agroforestry species or those with other economic interests, leaving the mycorrhizal status of the vast majority of native trees uninvestigated. Increased knowledge about symbiotic relationships between AMF and native plants will reveal crucial adaptive strategies of plants in nutritionally poor soils, elucidate mechanisms of resistance to environmental stresses, guide more efficient reforestation programs, and provide insights into the functional diversity of AMF in the region. Furthermore, such knowledge is essential for the development of specific bioinoculants that will enhance recovery of degraded areas and contribute to sustainable productivity in Amazonian systems.

For future advancement, we recommend: (i) including geographic areas not yet investigated; (ii) increasing the use of molecular techniques to identify taxonomic and functional diversity of Amazonian AMF as complementary tools for morphological identification; (iii) increasing study of the mycorrhizal associations with native plant species; (iv) studies of temporal dynamics of this symbiosis in the face of climate change and increasing anthropization of the region; and (v) applied investigations on the biotechnological potential of native AMF for ecological restoration and sustainable agroforestry systems.

CONCLUSIONS

Our review demonstrates that current knowledge on AMF in the Amazon remains markedly limited. Despite harboring high AMF diversity with several newly described taxa, most studies remain focused on traditional morphological assessments of colonization and spore-based diversity. The concentration of studies in specific regions and the fact that less than 2% of the Amazonian flora has been evaluated for mycorrhizal associations highlight a significant gap between the ecological relevance of AMF and the evidence available to understand their roles in this biome.

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SUPPLEMENTARY MATERIAL

Queiroz *et al*. Mapping knowledge on Arbuscular Mycorrhizal Fungi in the Amazon rainforest: a systematic review of diversity, distribution and symbiotic interactions

Table S1. Chronological list of the publications used in the analyses of Arbuscular Mycorrhizal Fungi in the Amazon.

Code	Reference
1	John, T.V.S. 1980. A survey of micorrhizal infection in an Amazonian rain forest. *Acta Amazonica* 10(3): 527-533.
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Table S1. Continued

Code	Reference
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Table S1. Continued

Code	Reference
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Table S2. Arbuscular Mycorrhizal Fungi species list from Amazonian countries, based on published studies. The numbers in the table cells correspond to the reference codes in Table S1.

AMF taxa	Brazil	Colombia	Ecuador	Peru
Archaeosporales				
Archaeosporaceae				
Archaeospora				
Archaeospora myriocarpa (Spain, Sieverd. & N.C. Schenck) Oehl, G.A. Silva, B.T. Goto & Sieverd.	79			
Archaeospora trappei (R.N. Ames & Linderman) J.B. Morton & D. Redecker	25, 31, 33, 35, 49, 54, 79, 87, 89, 90	78		30, 37
Archaeospora undulata (Sieverd.) Sieverd., G.A. Silva, B.T. Goto & Oehl				37, 107
Archaeospora schenckii (Sieverd. & S. Toro) C. Walker & A. Schüßler				30
Ambisporaceae				
Ambispora				
Ambispora appendicula (Spain, Sieverd. & N.C. Schenck) C. Walker	33, 35, 44, 64			65, 67, 68, 81, 84, 88, 107
Ambispora callosa (Sieverd.) C. Walker, Vestberg & A. Schüßler				30
Ambispora fennica C. Walker, Vestberg & A. Schüßler		62, 79		
Ambispora gerdemannii (S.L. Rose, B.A. Daniels & Trappe) C. Walker, Vestberg & A. Schüßler	10			37
Ambispora leptoticha (N.C. Schenck & G.S. Smith) C. Walker, Vestberg & A. Schüßler	8, 17, 25, 26, 31, 34, 47, 55, 79, 89	18, 62, 78, 79, 98		
Ambispora reticulata Oehl & Sieverd.				107
Polonosporaceae				
Polonospora				
Polonospora polonica (Błaszk.) Błaszk., Niezgoda, B.T. Goto & Magurno	31			
Diversisporales				
Acaulosporaceae				
Acaulospora				
Acaulospora aspera Corazon-Guivin, Oehl & G.A. Silva				58
Acaulospora bireticulata F.M. Rothwell & Trappe	25, 44			
Acaulospora brasiliensis B.T. Goto, L.C. Maia & Oehl		61		37
Acaulospora colombiana (Spain & N.C. Schenck) Kaonongbua, J.B. Morton & Bever	8, 10, 17, 25, 26, 27, 31, 35, 33, 34, 49, 54, 79, 87, 89			30
Acaulospora delicata C. Walker, C.M. Pfeiffer & Bloss	25, 26, 31, 33, 49, 53, 64, 89			
Acaulospora denticulata Sieverd. & S. Toro	10, 47, 51			
Acaulospora dilatata J.B. Morton	89			84
Acaulospora elegans Trappe & Gerd.	64			
Acaulospora endographis B.T. Goto	32			
Acaulospora excavata Ingleby & C. Walker	31, 51			
Acaulospora flava Corazon-Guivin, G.A. Silva & Oehl				73
Acaulospora flavopapillosa Corazon-Guivin, G.A. Silva & Oehl				83
Acaulospora foveata Trappe & Janos	8, 10, 25, 26, 27, 31, 33, 34, 35, 47, 49, 51, 54, 55, 64, 80, 90, 94	18, 21		30, 65, 67, 68, 81
Acaulospora fragilissima D. Redecker, Crossay & Cilia				84
Acaulospora gedanensis Blaszk.	31			
Acaulospora herrerae Furrazola, B.T. Goto, G.A. Silva, Sieverd. & Oehl				65, 84
Acaulospora ignota Błaszk., Góralska, Chwat & Goto				65
Acaulospora kentinensis C.G. Wu & Y.S. Liu ex Kaonongbua, J.B. Morton & Bever			45, 60	37

Table S2. Continued

AMF taxa	Brazil	Colombia	Ecuador	Peru
Acaulospora lacunosa J.B. Morton	55, 79, 90			81, 88
Acaulospora laevis Gerd. & Trappe	27, 31, 33, 34, 55			
Acaulospora longula Spain & N.C. Schenck			45	30, 37
Acaulospora mellea Spain & N.C. Schenck	8, 10, 17, 25, 27, 34, 35, 44, 47, 49, 54, 55, 64, 80, 87 , 90, 94			37, 65, 67, 68, 81, 88, 107
Acaulospora morrowiae Spain & N.C. Schenck	8, 10, 25, 26, 31, 35, 47, 49, 51, 53, 55, 64, 79, 89, 90	18, 98		107
Acaulospora papillosa C.M.R. Pereira & Oehl		98		
Acaulospora paulinae Blaszk.	31			
Acaulospora punctata Oehl, Palenzuela, I.C. Sánchez, G.A. Silva, C. Castillo & Sieverd.	79			37, 108
Acaulospora reducta Oehl, B.T. Goto & C.M.R. Pereira	64			
Acaulospora rehmii Sieverd. & S. Toro	10, 25, 31, 33, 34, 35, 44, 47, 51, 55, 64	98		37, 67, 68, 81
Acaulospora rugosa J.B. Morton				65, 67, 68, 81, 88
Acaulospora scrobiculata Trappe	10, 17, 25, 27, 31, 33, 34, 44, 47, 49, 51, 54, 64, 79, 87, 90, 94		60	37, 67, 92
Acaulospora spinosa C. Walker & Trappe	10, 25, 26, 31, 33, 44, 47, 64, 87		93	30, 37, 108
Acaulospora spinosissima Oehl, Palenzuela, Sánchez-Castro, Tchabi, Hountondji & G.A. Silva	79			37, 81, 88
Acaulospora splendida Sieverd., Chaverri & I. Rojas				108
Acaulospora sporocarpia S.M. Berch	34			
Acaulospora tuberculata Janos & Trappe	8, 10, 17, 25, 26, 27, 31, 33, 34, 47, 48, 55, 80, 89, 94	18		30, 37, 63, 65, 67, 68, 81
Acaulospora walkeri Kramadibrata & Hedger	31, 33, 49, 54			
Diversisporaceae				
Corymbiglomus				
Corymbiglomus corymbiforme Błaszk. & Chwat	31, 33, 49			
Sieverdingia				
Sieverdingia tortuosa (N.C. Schenck & G.S. Smith) Błaszk., Niezgoda & B.T. Goto	27, 31, 33, 34, 44, 79	98		107
Diversispora				
Diversispora aurantia (Blaszk., Blanke, Renker & Buscot) C. Walker & A. Schüßler				92, 107
Diversispora eburnea (L.J. Kennedy, J.C. Stutz & J.B. Morton) C. Walker & A. Schüßler				30, 107
Diversispora epigaea (B.A. Daniels & Trappe) C. Walker & A. Schüßler	79			
Diversispora spurca (C.M. Pfeiffer, C. Walker & Bloss) C. Walker & A. Schüßler				30, 37
Diversispora trimurales (Koske & Halvorson) C. Walker & A. Schüßler				81
Diversispora versiformis (P. Karsten) Oehl, G.A. Silva & Sieverd.	35			37, 84
Redeckera				
Redeckera fulva (Berk. & Broome) C. Walker & A. Schüßler		78		
Pacisporaceae				
Pacispora				
Pacispora franciscana Sieverd. & Oehl	44			
Pacispora robigina Sieverd. & Oehl	35			

Table S2. Continued

AMF taxa	Brazil	Colombia	Ecuador	Peru
Gigasporales				
Dentiscutataceae				
Dentiscutata				
Dentiscutata biornata (Spain, Sieverd. & S. Toro) Sieverd., F.A. Souza & Oehl	31, 33, 54, 79, 87, 89, 90			
Dentiscutata cerradensis (Spain & J. Miranda) Sieverd., F.A. Souza & Oehl	35, 79, 89			
Dentiscutata erythropus (Koske & C. Walker) C. Walker & D. Redecker	8, 89			
Dentiscutata heterogama (T.H. Nicolson & Gerd.) Sieverd., F.A. Souza & Oehl	8, 10, 17, 27, 34, 54, 55, 87, 89, 90	62, 78, 79		30, 84
Dentiscutata savannicola (R.A. Herrera & Ferrer) C. Walker & A. Schüßler	79			
Dentiscutata scutata (C. Walker & Diederichs) Sieverd., F.A. Souza & Oehl	27, 31, 33, 34, 54, 64			
Fuscutata				
Fuscutata aurea Oehl, C.M. Mello & G.A. Silva	79			
Fuscutata heterogama Oehl, F.A. Souza, L.C. Maia & Sieverd.	51, 64			37
Fuscutata rubra (Stürmer & J.B. Morton) Oehl, F.A. Souza & Sieverd.	89			
Gigasporaceae				
Gigaspora				
Gigaspora albida N.C. Schenck & G.S. Smith	79, 89, 90			
Gigaspora candida Bhattacharjee, Mukerji, J.P. Tewari & Skoropad	94			
Gigaspora decipiens I.R. Hall & L.K. Abbott	90	62, 78, 79		30
Gigaspora gigantea (T.H. Nicolson & Gerd.) Gerd. & Trappe	8, 10, 89, 90			30
Gigaspora margarita W.N. Becker & I.R. Hall	8, 25, 28, 49, 53, 54, 64, 79, 87, 89, 94			107
Gigaspora rosea T.H. Nicolson & N.C. Schenck	35, 89			
Racocetraceae				
Cetraspora				
Cetraspora pellucida (T.H. Nicolson & N.C. Schenck) Oehl, F.A. Souza & Sieverd.	31, 33, 34, 51, 54, 89, 90, 94	18		37
Racocetra				
Racocetra castanea (C. Walker) Oehl, F.A. Souza & Sieverd.	35, 44	62, 78, 79		30
Racocetra coralloidea (Trappe, Gerd. & I. Ho) Oehl, F.A. Souza & Sieverd.	89			
Racocetra fulgida (Koske & C. Walker) Oehl, F.A. Souza & Sieverd.	34, 54, 79, 89, 90			
Racocetra gregaria (N.C. Schenck & T.H. Nicolson) Oehl, F.A. Souza & Sieverd.	28, 89			
Racocetra persica (Koske & C. Walker) Oehl, F.A. Souza & Sieverd.	31			
Racocetra verrucosa (Koske & C. Walker) Oehl, F.A. Souza & Sieverd.	34			
Racocetra weresubiae (Koske & C. Walker) Oehl, F.A. Souza & Sieverd.	10, 54			
Scutellosporaceae				
Bulbospora				
Bulbospora minima Oehl, Marinho, B.T. Goto & G.A. Silva	90			
Orbispora				
Orbispora pernambucana (Oehl, D.K. Silva, N. Freitas, L.C. Maia) Oehl, G.A.Silva & D.K. Silva	51, 54, 64			
Scutellospora				
Scutellospora arenicola Koske & Halvorson	35			
Scutellospora calospora (T.H. Nicolson & Gerd.) C. Walker & F.E. Sanders	10, 35, 44, 51, 89, 94			
Scutellospora dipurpurescens J.B. Morton & Koske	35, 79, 89			

Table S2. Continued

AMF taxa	Brazil	Colombia	Ecuador	Peru
Glomerales				
Septoglomeraceae				
Blaszkowskia				
Blaszkowskia deserticola (Trappe, Bloss & J.A. Menge) G.A. Silva, Oehl & Sieverd.				30
Funneliformis				
Funneliformis caledonium (T.H. Nicolson & Gerd.) C. Walker & A. Schüßler	47, 89			
Funneliformis coronatum (Giovann.) C. Walker & A. Schüßler		98		
Funneliformis geosporum (T.H. Nicolson & Gerd.) C. Walker & A. Schüßler	8, 10, 31, 35, 44, 47, 64, 89			5, 67, 68, 81, 107
Funneliformis halonatus (S.L. Rose & Trappe) Oehl, G.A. Silva & Sieverd.	51, 64			
Funneliformis mosseae (T.H. Nicolson & Gerd.) C. Walker & A. Schüßler	79, 89			84
Funneliformis verruculosum (Blaszk.) C. Walker & A. Schüßler	34			
Funneliglomus				
Funneliglomus sanmartinensis Corazon-Guivin, G.A. Silva & Oehl				56
Septoglomus				
Septoglomus constrictum (Trappe) Sieverd., G.A. Silva & Oehl	89			108
Viscospora				
Viscospora viscosa (T.H. Nicolson) Sieverd., Oehl & F.A. Souza		18, 78		
Glomeraceae				
Glomus				
Glomus ambisporum G.S. Smith & N.C. Schenck	34, 64			
Glomus brohultii R.A. Herrera, Ferrer & Sieverd.				30, 37
Glomus clavisporum (Trappe) R.T. Almeida & N.C. Schenck	27, 31, 47			
Glomus dominikii Blaszk.				37
Glomus formosanum C.G. Wu & Z.C. Chen	8, 10, 47, 94			
Glomus fuegianum (Speg.) Trappe & Gerd.	35			
Glomus glomerulatum Sieverd.	8, 10, 31, 33, 47, 49, 64, 80			
Glomus heterosporum G.S. Smith & N.C. Schenck	35			
Glomus macrocarpum Tul. & C. Tul.	8, 10, 17, 27, 28, 34, 35, 47, 64, 94			5, 81, 88, 107, 108
Glomus magnicaule I.R. Hall	8, 47			
Glomus microcarpum Tul. & C. Tul.	8, 10, 27, 35, 47			5, 30
Glomus multicaule Gerd. & B.K. Bakshi	89			
Glomus nanolumen Koske & Gemma	8, 10, 47			
Glomus reticulatum Bhattacharjee & Mukerji	8, 10, 47			
Glomus rubiforme (Gerd. & Trappe) R.T. Almeida & N.C. Schenck	27, 31, 35, 44, 80			30, 37
Glomus spinuliferum Sieverd. & Oehl	80			
Glomus taiwanense (C.G. Wu & Z.C. Chen) R.T. Almeida & N.C. Schenck	35, 80			
Glomus trufemii B.T. Goto, G.A. Silva & Oehl	64			
Simiglomus				
Simiglomus hoi (S.M. Berch & Trappe) G.A. Silva, Oehl & Sieverd.	89			91
Sclerocarpum				
Sclerocarpum amazonicum Jobim, Błaszk., Niezgoda, Kozłowska & B.T. Goto	62			
Dominikiaceae				
Nanoglomus				
Nanoglomus plukenetiae Corazon-Guivin, G.A. Silva & Oehl				59, 97, 106
Dominikia				
Dominikia minuta (Błaszk., Tadych & Madej) Błaszk., Chwat & Kovács	35, 80			

Table S2. Continued

AMF taxa	Brazil	Colombia	Ecuador	Peru
Kamienskiaceae				
Microkamienskia				
Microkamienskia peruviana Corazon-Guivin, G.A. Silva & Oehl				57, 84, 91, 92
Sclerocystaceae				
Rhizoglomus				
Rhizoglomus aggregatum (N.C. Schenck & G.S. Sm.) Sieverd., G.A. Silva & Oehl				67, 84
Rhizoglomus cacao Corazon-Guivin, G.A. Silva & Oehl				85
Rhizoglomus clarum (T.H. Nicolson & N.C. Schenck) Sieverd., G.A. Silva & Oehl	10, 17, 25, 26, 31, 33, 47, 53, 60, 80, 89, 94, 104	18, 63, 78, 79		30
Rhizoglomus dunense Błaszk. & Kozłowska				84
Rhizoglomus fasciculatum (Thaxter) Sieverd., G.A. Silva & Oehl	2, 34, 80, 90			37
Rhizoglomus intraradices (N.C. Schenck & G.S. Sm.) Sieverd., G.A. Silva & Oehl	10, 31, 33, 47, 80, 89	63, 78, 79		68
Rhizoglomus invermaium (I.R. Hall) Sieverd., G.A. Silva & Oehl	10, 31, 47			30, 107
Rhizoglomus microaggregatum (Koske, Gemma & P.D. Olexia) Sieverd., G.A. Silva & Oehl	31	21, 76		30
Rhizoglomus proliferum (Dalpé & Declerck) Sieverd., G.A. Silva & Oehl		78	45, 61	
Rhizoglomus variabile Corazon-Guivin, Oehl & G.A. Silva				66, 84, 97, 106
Sclerocystis				
Sclerocystis coremioides Berk. & Broome	31, 80, 89	78, 79		5, 30, 37
Sclerocystis sinuosa Gerd. & B.K. Bakshi	31, 47, 51, 80			30, 67, 68, 81, 88, 107
Oehlia				
Oehlia diaphana (J.B. Morton & C. Walker) Błaszk. Kozłowska & Dalpé	10, 35, 47, 80, 89			30, 37
Paraglomerales				
Paraglomeraceae				
Paraglomus				
Paraglomus brasilianum (Spain & J. Miranda) J.B. Morton & D. Redecker	89	63, 79		
Paraglomus occultum (C. Walker) J.B. Morton & D. Redecker	8, 10, 25, 47, 89	63, 78, 79		30, 37, 81
Paraglomus occidentale Corazon-Guivin, G.A. Silva & Oehl				69
Paraglomus laccatum (Błaszk.) Renker, Błaszk. & Buscot		78		
Paraglomus peruvianum Corazon-Guivin, G.A. Silva & Oehl				84, 86
Entrophosporales				
Entrophosporaceae				
Albahypha				
Albahypha drummondii (Błaszk. & Renker) Błaszk., Niezgoda, B.T. Goto & Magurno	35			
Entrophospora				
Entrophospora infrequens (I.R. Hall) R.N. Ames & R.W. Schneider	25, 26, 31, 51, 80			
Entrophospora claroidea (N.C. Schenck & G.S. Smith) Błaszk., Niezgoda, B.T. Goto & Magurno	8, 10, 25, 26, 28, 35, 89			37
Entrophospora etunicata (W.N. Becker & Gerd.) Błaszk., Niezgoda, B.T. Goto & Magurno	8, 10, 26, 27, 28, 35, 41, 44, 47, 53, 55, 60, 64, 80, 89, 94, 104			37, 84, 91, 92, 107
Entrophospora lamellosa (Dalpé, Koske & Tews) Błaszk., Niezgoda, B.T. Goto & Magurno	34, 89	63, 78, 79		
Entrophospora lutea (L.J. Kennedy, J.C. Stutz & J.B. Morton) Błaszk., Niezgoda, B.T. Goto & Magurno	35			30, 37
Total number of species	**105**	**26**	**5**	**74**

Table S3. Plant species list studied for their symbiotic profiles with Arbuscular Mycorrhizal Fungi in the Amazon region. The table indicates the observed AMF structures: H = hyphae, V = vesicles, S = spores, A = arbuscules. The "+" symbol denotes observed colonization without specification of the structures, while "-" indicates that no arbuscular mycorrhizal colonization was observed. The numbers correspond to the reference codes in Table S1.

Families/*species*	Presence/structures of AMF
Annonaceae	
Unonopsis stipitata Diels	+[1]
Apocynaceae	
Geissospermum argenteum Woodson	+[1]
Araceae	
Anthurium sp.	A, S, V[61]
Caladium sp.	A, S, V[61]
Araliaceae	
Dendropanax sp.	A, S, V[61]
Arecaceae	
Attalea speciosa Mart.	+[51]
Bactris gasipaes Kunth	+[4], S, H, A[15]
Elaeis guineensis Jacq.	+[74]
Euterpe precatoria Mart.	+[45], A, S, V[61], +[89]
Geonoma macrostachys Mart.	A, S, V[61]
Mauritia flexuosa L.f.	+[89]
Oenocarpus bacaba Mart.	+[1]
Syagrus sp.	-[1]
Bignoniaceae	
Tabebuia serratifolia (Vahl) G. Nichols.	+[3]
Boraginaceae	
Cordia sp.	A, S, V[61]
Burseraceae	
Protium paraense Cuatrec.	+[1]
Protium pedicellatum Swart	+[1]
Protium sp.	+[1]
Tetragastris sp.	+[1]
Calophyllaceae	
Calophyllum brasiliense Cambess.	+[3]
Caryocaraceae	
Caryocar pallidum A.C.Sm.	+[1]
Cecropiaceae	
Pourouma sp.	A, S, V[61]
Celastraceae	
Salacia impressifolia (Miers) A.C.Sm.	-[1]
Salacia sp.	-[1]
Chrysobalanaceae	
Couepia canomensis (Mart.) Benth. ex Hook.f.	+[1]
Couepia obovata Ducke	+[1]
Licania parviflora var. *pallida* Hook.f.	+[1]
Combretaceae	
Buchenavia sp.	+[1]

Table S3. Continued

Families/*species*	**Presence/structures of AMF**
Connaraceae	
Rourea sp.	-[1]
Costaceae	
Costus lima K.Schum.	+[45]
Costus pulverulentus C.Presl	+[45]
Costus scaber Ruiz & Pav.	A[45]
Costus sp.	A, S, V[61]
Cyatheaceae	
Cyathea sp.	A, S, V[61]
Cyclanthaceae	
Carludovica palmata Ruiz & Pav.	S, V, H[45]
Cyclanthus bipartitus Poit. ex A. Rich.	A, S, V[61]
Dichapetalaceae	
Tapura guianensis Aubl.	+[1]
Dryopteridaceae	
Stigmatopteris sp.	A, S, V[61]
Elaeocarpaceae	
Sloanea guianensis (Aubl.) Benth.	+[1]
Erythropalaceae	
Heisteria sp.	-[1]
Euphorbiaceae	
Acalypha sp.	A, S, V[61]
Hevea brasiliensis (Willd. ex A. Juss.) Müll.Arg.	A, H[28], +[78]
Plukenetia volubilis L.	+[56, 57, 58, 59, 66, 69, 73, 83, 84, 86, 106]
Fabaceae	
Acacia mangium Willd.	+[10]
Acacia sp.	A, S, V[61]
Arachis pintoi Krapov. & W.C.Greg.	+[27]
Cajanus cajan (L.) Huth	A, S, V, H[65]
Canavalia ensiformis (L.) DC.	A, S, V, H[65]
Cedrelinga cateniformis (Ducke) Ducke	+[3]
Crotalaria juncea L.	A, S, V, H[65]
Dalbergia sp.	+[1]
Dicorynia guianensis Amsh.	+[40]
Diplotropis sp.	+[3]
Dipteryx odorata (Aubl.) Forsyth f.	+[1, 3]
Dipteryx polyphylla Huber	+[3]
Eperua bijuga Mart. ex Benth.	+[3]
Eperua falcata Aubl.	+[40]
Inga auristellae Harms	A, S, V[61]
Inga sp.	+[12]
Peltogyne paniculata Benth.	+[1]
Pithecellobium racemosum (Ducke) Killip	+[1, 3]

Table S3. Continued

Families/*species*	**Presence/structures of AMF**
Schizolobium amazonicum Huber ex Ducke	+ [23]
Schizolobium parahyba (Vell.) Blake	+ [41]
Sclerolobium paniculatum Vogel	+ [10]
Swartzia reticulata Ducke	- [1]
Swartzia sp.	- [1]
Tachigali melinonii (Harms) Zarucchi & Herend.	+ [40]
Vigna unguiculata (L.) Walp.	+ [9, 26, 46, 53, 89], A, S, V, H [65]
Vouacapoua pallidior Ducke	- [3]
Zygia racemosa (Ducke) Barneby & J.W.Grimes	
Gentianaceae	
Voyriella parviflora Miq.	+ [95]
Gnetaceae	
Gnetum sp.	- [1]
Goupiaceae	
Goupia glabra Aubl.	+ [3]
Heliconiaceae	
Heliconia sp.	A, S, V [61]
Humiriaceae	
Sacoglottis ceratocarpa Ducke	+ [1]
Sacoglottis mattogrossensis Malme	+ [1]
Lauraceae	
Aniba duckei Kosterm.	+ [76]
Licaria aurea (Huber) Kosterm.	+ [1]
Licaria sp.	+ [1]
Sextonia rubra (Mez) van der Werff	+ [1]
Lecythidaceae	
Cariniana decandra Ducke	H [6]
Cariniana micrantha Ducke	H [6]
Chytroma parvifructa (S.A.Mori) O.M.Vargas & C.W.Dick	H [6]
Corythophora alta R.Knuth	- [1], H [6]
Corythophora rimosa W.A.Rodrigues	- [1], H [6]
Couratari guianensis Aubl.	- [1], H [6]
Couratari longipedicellata W.A.Rodrigues	H [6]
Couratari multiflora (Sm.) Eyma	H [6]
Couratari stellata A.C.Sm.	H [6]
Eschweilera amazoniciformis S.A.Mori	H [6]
Eschweilera apiculata A.C.Sm.	H [6]
Eschweilera atropetiolata S.A.Mori	H [6]
Eschweilera bracteosa Miers	H [6]
Eschweilera collina Eyma	H [6]
Eschweilera coriacea (DC.) S.A.Mori	+ [1],H [6]
Eschweilera cyathiformis S.A.Mori	H [6]
Eschweilera grandifolia Mart. ex DC.	H [6]

Table S3. Continued

Families/*species*	**Presence/structures of AMF**
Eschweilera laevicarpa S.A.Mori	H [6]
Eschweilera pedicellata (Rich.) S.A.Mori	H [6]
Eschweilera polyantha A.C.Sm.	+ [1]
Eschweilera pseudodecolorans S.A.Mori	H [6]
Eschweilera romeu-cardosoi S.A.Mori	H [6]
Eschweilera tessmannii R.Knuth	H [6]
Eschweilera truncata A.C.Sm.	H [6]
Eschweilera wachenheimii Sandwith	H [6]
Gustavia elliptica S.A.Mori	H [6]
Lecythis barnebyi S.A.Mori	H [6]
Lecythis chartacea O.Berg	H [6]
Lecythis idatimon Aubl.	+ [1]
Lecythis lurida (Miers) S.A.Mori	- [1]
Lecythis retusa Spruce ex O. Berg	H [6]
Pachylecythis pisonis O.M.Vargas & C.W.Dick	H [6]
Pachylecythis zabucajo Aubl.	H [6]
Malvaceae	
Lueheopsis rosea (Ducke) Burret	+ [1]
Scleronema micranthum Ducke	+ [1]
Sterculia sp.	+ [1]
Theobroma cacao L.	+ [85, 91, 103]
Theobroma grandiflorum (Willd. ex Spreng.) K. Schum.	+ [11, 14], H, A [15], + [29]
Theobroma sp.	+ [1]
Marantaceae	
Calathea sp.	A, S, V [61]
Melastomataceae	
Bellucia imperialis Saldanha & Cogn.	+ [94]
Leandra sp.	A, S, V [61]
Miconia sp.	A, S, V [61]
Mouriri lunatanthera Morley	- [1]
Meliaceae	
Carapa guianensis Aubl.	+ [3]
Swietenia macrophylla King in Hook.	A, S, V, H [7], +[76]
Trichilia weddellii C.DC.	+ [1]
Moraceae	
Brosimum parinarioides Ducke	+ [1]
Brosimum utile (Kunth) Oken	+ [1]
Brosimum sp.	+ [1]
Clarisia racemosa Ruiz & Pav.	+ [3]
Ficus sp.	- [1]
Helicostylis sp.	- [1]
Helicostylis tomentosa (Poepp. & Endl.) J.F.Macbr.	- [1]
Naucleopsis caloneura (Huber) Ducke	+ [1]

Table S3. Continued

Families/*species*	**Presence/structures of AMF**
Musaceae	
Musa sp.	+ [13]
Myrtaceae	
Eugenia citrifolia Poir.	+ [1]
Eugenia egensis DC.	+ [1]
Myrciaria dubia (Kunth) McVaugh	A, S, V, H [107]
Nyctaginaceae	
Neea altissima Poepp. & Endl.	- [1]
Neea sp.	- [1]
Ochnaceae	
Ouratea discophora Ducke	+ [1]
Olacaceae	
Minquartia guianensis Aubl.	+ [1]
Piperaceae	
Piper aduncum L.	H, A, V [60]
Piper callosum Ruiz & Pav.	+ [104]
Piper sp.	A, S, V [61]
Poaceae	
Urochloa decumbens (Stapf) R.D.Webster	+ [12], S, H, A, V[19]
Guadua weberbaueri Pilg.	+ [89]
Saccharum officinarum L.	+ [89]
Quiinaceae	
Quiina pteridophylla (Radlk.) Pires	- [1]
Rosaceae	
Fragaria sp.	+ [2]
Rubiaceae	
Cinchona officinalis L.	+ [102, 108]
Coffea arabica L.	+ [67, 68, 73,82, 83, 84, 86, 88, 97],V, H [81]
Faramea sp.	S,V [61]
Rudgea sp.	+ [1]
Uncaria guianensis (Aubl.) J.F.Gmel.	H, V, A[98]
Uncaria tomentosa DC.	H, V, A[98]
Flacourtiaceae	
Laetia procera (Poepp.) Eichler	- [1]
Sapindaceae	
Paullinia cupana Kunth	+ [11, 14, 29,] A, V, H [52]
Paullinia sp.	S, V [61]
Sapotaceae	
Pouteria sagotiana (Baill.) Eyma	+ [1]
Pouteria caimito (Ruiz & Pav.) Radlk.	- [1]
Pouteria cladantha Sandwith	+ [1]
Pouteria guianensis Aubl.	- [1]
Prieurella sp.	+ [1]

Table S3. Continued

Families/*species*	**Presence/structures of AMF**
Siparunaceae	
Siparuna sp.	+ [1]
Solanaceae	
Capsicum annuum L.	H, V, A [21]
Capsicum baccatum L.	H [21]
Capsicum chinense Jacq.	H, V, A [21]
Capsicum frutescens L.	H, V, A [21]
Capsicum pubescens Ruiz & Pav.	H, V [21]
Capsicum sp.	H, V, A [21]
Duckeodendron cestroides Kuhlm.	+ [1]
Urticaceae	
Urera baccifera (L.) Gaudich. ex Wedd.	A, S,V [61]
Urera caracasana (Jacq.) Griseb.	A, S, V [61]
Violaceae	
Rinorea sp.	+ [1]
Vochysiaceae	
Erisma bicolor Ducke	+ [1]
Erisma fuscum Ducke	+ [1]
Qualea paraensis Ducke	+ [1]
Qualea sp.	+ [1]
Zingiberaceae	
Renealmia sp.	A, S, V [61]