Chapter 9
Tropical Dry Forest Compared to Rainforest and Associated Ecosystems in Brazil

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9.1 Introduction

The arbuscular mycorrhizal fungi (AMF) links the plants and geochemical components of the ecosystems providing important ecosystem services. Research on Mycorrhizas has gone through different stages (Pagano 2016), but their importance in natural ecosystems is nowadays increasingly recognized. Commom AMF species composition differs in each paleocontinent, while endemic species are usually rare (Davison et al. 2015). For example, *Funneliformis mosseae* is considered a widespread generalist (Öpik et al. 2006), frequent in grasslands and arable lands and less associated to forests (Bouffaud et al. 2016). AMF density and distribution vary both spatially and temporally within and between species, being influenced by soil types and host plant species diversity. Some AM fungi, for example, are only found in specific soil nutrient conditions (Valyi et al. 2016).

Natural forest ecosystems and their associated vegetation types were not fully investigated, and the deep soil layers should also be included in studies to get a complete picture of AMF diversity, as they can show different composition than the topsoil (Oehl et al. 2005). In the same way, trap cultures are a useful tool to better understand the AMF ecology of native plant communities and are useful to confirm the results of a higher or lower species richness obtained from different vegetation types.

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A recent review about AMF in tropical forests worldwide (Marinho et al. 2018) showed that 228 species belonging to 14 families and 35 genera of Glomeromycotina were registered in tropical forests. This number of species represents 75% of the known richness of this group of symbiotic fungi, and the authors pointed out that the largest numbers of these AMF species are from Dry forests.

In Brazil, the tropical dry forests are most located in the Northeast semiarid region and in the Midwest and Southeast, being characterized by high temperature and low humidity due to severe periods of drought. In the semiarid Northeast the characteristic vegetation is known as 'Caatinga', and the plants are adapted to tolerate the dry season through different mechanisms including deciduousness, presence of spines, bodies for water storage, small leaf area and deep roots (Giulietti et al. 2006). The dry forests of the other regions are savannas, most known as 'Cerrado' and 'Cerradão', that extends from the margin of the Amazonian forest to the Midwest and Southeast region, presenting, diverse physiognomies ranging from dense grassland, in general sparsely covered by shrubs and small trees, to an almost closed woodland with a canopy that reaches 12–15 m height (Ratter et al. 1997). All native plants are adapted to live in its variable arid climate and many support fire. Highlands and rupestrian fields and grasslands at altitudes between 800 m and 2000 m are sub-physiognomies of Cerrado (Rizzini 1997).

The Brazilian rainforest is mainly represented by the Amazon forest and the Atlantic forest, that includes the Araucaria forest in the South of Brazil, and encompasses, among other associated ecosystems: sand dunes, restingas and mangroves along the Atlantic coast of the country. An open forest, characteristic of the Pantanal biome and that differs from the Atlantic and Amazon forests occurs as a transition between the Amazonia forest and the Cerrado, in the Midwest.

In all these dry and humid forest environments AMF associations have been registered. This chapter discusses advances on diversity of arbuscular mycorrhizal fungi in natural forest ecosystems drawing on results of research in Brazil.

9.2 The Arbuscular Mycorrhizal Symbioses in Tropical Dry Forest

9.2.1 Caatinga

Arbuscular Mycorrhizal Fungi are well represented in semiarid lands, which are characterized by diverse vegetation types due to its soil, topography and climatic variation. Most thorny dry woody vegetation (caatinga vegetation); non-thorny dry forest and closed, non-thorny dry tall-shrubby vegetation (carrasco vegetation) presented AMF association and high AMF diversity (Pagano et al. 2013). As described by these authors, the *Arum*-type AM morphology was prevalent in roots and 32 AM fungal taxa (spore-based taxonomy) were isolated from rhizospheric soil samples collected in Caatinga areas, with *Glomus*, *Gigaspora* and *Cetraspora* being commonly found (Pagano et al. 2013). In general, compared to dry forest, woody caatinga presented higher sporulation and AMF diversity; however, carrasco vegetation was more similar to dry forest in their AMF species composition. Total AMF spore numbers were consistently similar in all sites, but the AMF spore ontogeny, varied between vegetational types: Deciduous Forest and Carrasco presented higher gigasporoid spore numbers, followed by glomeroid and acaulosporoid spores type (Fig. 9.1); while, the woody caatinga showed lower Gigasporales representants (Pagano et al. 2013).

Spore populations of AMF communities in dry forest are generally low in numbers and can vary between one to 2.8 spores g^{-1} soil (Mello et al. 2012; Pagano et al. 2013; Da Silva et al. 2014); however, it also depends on soil type and vegetation, as range of 0–10 glomerospores/g^{-1} soil was registered in different areas of tropical dry forest (Maia et al. 2015a). Studies in a Caatinga environmental gradient (a dry

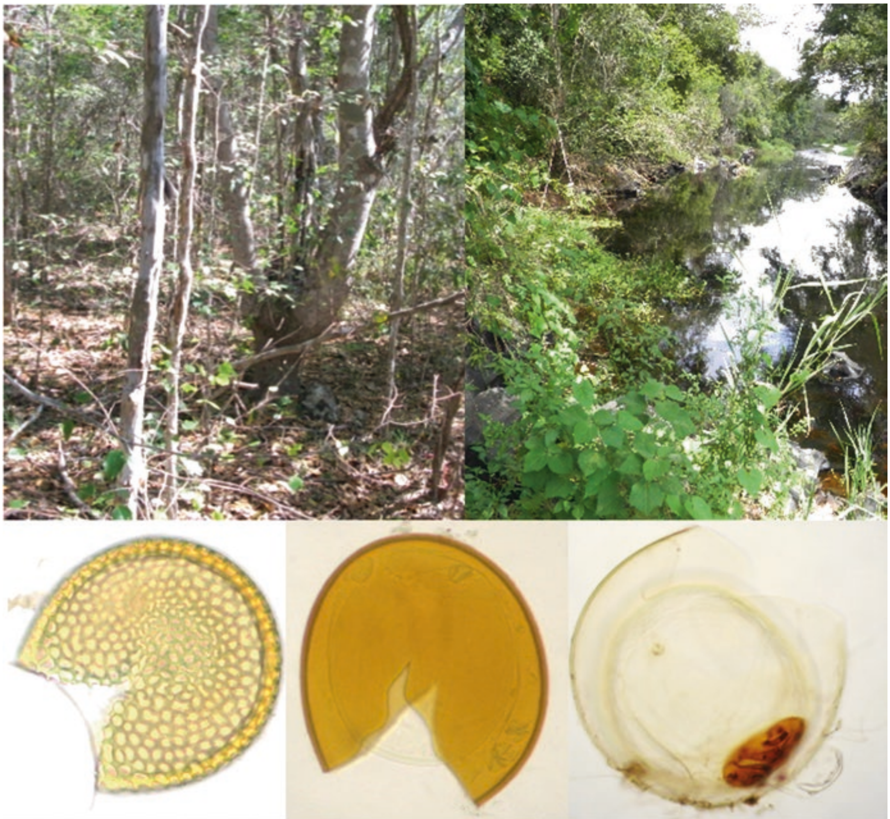

Fig. 9.1 Trees associated with mycorrhizas in native forests of Brazil and AM spores recovered from rhizospheric soils. Clockwise, from upper: dry forest and rainforest vegetation, spores (Gigasporales and *Acaulospora*) recovered from their rhizospheric soils (photos by M. Pagano and E. A. Correa)

forest, a transitional zone and a moist forest) showed the presence of AM association and high AMF diversity, trap cultures being of great importance as more species can be identified, such as those of *Glomus* (Da Silva et al. 2014).

Rarely more than 42 AMF species were reported in field studies performed in dry forests (Table 9.1). In general, species of Acaulosporaceae, Gigasporales, and Glomerales can be commonly found in dry forest; however, *Glomus* can predominate in transitional zone and moist forest (above 670 m.a.s.l.) (Da Silva et al. 2014). Near 60% of AMF species identified in dry forest ecosystems were retrieved from trap cultures, and among them 17% belonged to Glomeraceae, a few species such as *Glomus ambisporum* were obtained only from trap cultures (Da Silva et al. 2014). This is due to the fact that species of Glomeraceae display more extensive root colonization than other families and lower soil colonization by extraradical hyphae in addition to rapid colonization of new plant hosts from colonized roots fragments (Hart and Reader 2002).

New species have being described from Caatinga areas such as *Bulbospora minima* (Marinho et al. 2014), *Paraglomus pernambucanum* (Mello et al. 2013), *Racocetra intraornata* (Goto et al. 2009), *Septoglomus furcatum* (Błaszkowski et al. 2013) and *Septoglomus titan* (Goto et al. 2013). These new records show the need to better study the great estimated AMF species richness in Brazil, and, therefore, to the discovery of new species (de Souza et al. 2010).

9.2.2 Cerrado

Earlier studies that described AMF communities in Cerrado (e.g. Cordeiro et al., 2005; Ferreira et al. 2012) registered~11 AMF species. Plants in areas of a Cerrado *stricto sensu* presented low root colonization (30%) and AMF density varied from 7 to 8 spores g^{-1} soil (Cordeiro et al. 2005).

More recent studies analyzed the Murundu fields (characterized by termite mounds varying from 2 to 10 m in diameter and 2 m in height) that occur in some parts of the Cerrado biome in Goiás state, which were considered hotpots for AMF diversity (Assis et al. 2014). In that study, AM fungal community was represented by 27 species from eight genera and five families; *Acaulospora mellea, A. cavernata, A. colombiana, Oehlia diaphana* and *Dentiscutata reticulata* were commonly found.

The tropical wetland (Pantanal biome) was only recently investigated and in vegetation areas with different flooding regimes (flood-free, occasional flooding and seasonal flooding), 37 AMF species were registered (Gomide et al. 2014). The authors observed increasing spore numbers in “Cerradão”, the tallest Cerrado vegetation with a continuous and moderately closed canopy according to Andrade et al. (2002), and grassland soils and higher richness in Cerrado > areas exposed at low water/lowlands > “Cerradão”, corroborating the observations that AMF diversity is related to heterogeneity of vegetation (Gomide et al. 2014).

Table 9.1 Total number of identified AM fungal species in some natural Brazilian ecosystems

Ecosystem	Biome	Vegetation type/State/Region	AMF species	Reference
Forest	Amazonia	Terra firme forest, Central Amazonia	39	Freitas et al. (2014)
Forest	Atlantic forest	Mature forest, Paraná state, Southern	47	Zangaro et al. (2013)
Forest	Atlantic forest	Mature forest, Pernambuco state/Northeast	17	Pereira et al. (2014)
Forest	Atlantic forest/Cerrado	Riparian vegetation	27	Pagano and Cabello (2012)
Forest	Atlantic forest	Araucaria forest *(Araucaria angustifolia)*	18	Moreira et al. (2016)
Tropical wetland	Pantanal	Semi-deciduous forest, Cerrado, Cerradão, grasslands	21–25	Gomide et al. (2014)
Savanna forests	Cerrado	Natural Cerrado forest, Midwest	29–33	Pontes et al. (2017)
Savanna forests	Cerrado	Murundu fields[a], Goiás, Midwest	27	Assis et al. (2014)
Savanna forests	Cerrado	Highland fields[a], Minas Gerais, Southeast	8	Pagano and Scotti (2009)
			51	Oki et al. (2016)
			20	Costa et al. (2016)
Savanna forests	Cerrado	Ferruginous fields, Iron mining areas[a], Minas Gerais, Southeast	6	Pagano and Scotti (2010)
			59	Teixeira et al. (2017)
Savanna forests	Cerrado	High altitude Cerrado savanas, Bahia, Northeast	49	Vieira et al. (2019)
Dry forest	Caatinga	Montane forest, Pernambuco Montane forest, southern Ceará, Northeast	47	da Silva et al. (2014)
			52	Assis et al. (2018)
Dry forest	Caatinga	Dry forest, moist forest	27–42	da Silva et al. (2014), Assis et al. (2018)
Dry forest	Caatinga	Caatinga, Pernambuco, Northeast	16	Mello et al. (2012)
Dry forest	Caatinga	Deciduous Forest, Northeast	13–15	Pagano et al. (2013)
Dry tall-shrubby vegetation	Caatinga	Carrasco, Northeast	16–18	Pagano et al. (2013)

(continued)

Table 9.1 (continued)

Ecosystem	Biome	Vegetation type/State/ Region	AMF species	Reference
Dry woody savanna vegetation	Caatinga	Woody caatinga, Northeast	9–23	Pagano et al. (2013)
Sand dunes and Coastal ecosystems	Atlantic forest	Sand dunes and Restinga forest, South	10–53	da Silva et al. (2012), Stürmer et al. (2013), Souza et al. (2013), Silva et al. (2015a), Silva et al. (2015b), Silva et al. (2017)
Sand dunes and Coastal ecosystems	Atlantic Forest	Mangrove forest, restinga forest, Northeast	17–22	Silva et al. (2017)

aReported as AMF hotspots sites

The southeast Brazilian Highlands or Rupestrian fields were also investigated regarding AM fungal communities. These areas have shrubby, tortuous and sclerophyllous vegetation or grasses that grow in stones, in sandy soils and present varied adaptations (Rizzini 1997).

For a recent list of AMF species in Cerrado Rupestrian grasslands see Oki et al. (2016). The specialized vegetation types in such environment present high herbaceous species richness, high endemism (species of Asteraceae, Euphorbiaceae, Melastomataceae and Velloziaceae), and unique plant and fungal species compositions, among other organisms, resulting in megadiverse ecosystems (Fernandes 2016). Thus, these areas have been pointed out as a hotspot of diversity for AMF and endophytic fungi, whose relations need to be more understood (Oki et al. 2016). In this rupestrian ecosystem Coutinho et al. (2015) reported the presence of 22% of the known world diversity of AMF.

Recent studies in tropical mountain ecosystems, such as in the Chapada Diamantina in Bahia (NE Brazil) where predominates rupestrian fields showed that the AMF communities were related to the heterogeneity of habitats, including silt and coarse sand contents as the main factors. Among the 49 identified AMF species, members of Glomeraceae and Acaulosporaceae were the most representative. The AMF communities did not follow the shifts in plant communities. The high altitude savannas (Cerrado) and natural rocky rupestrian fields (shrublands), differed in the composition of the AMF communities (Vieira et al. 2019).

In other Cerrado areas of Minas Gerais, earlier studies have shown AM colonization and glomerospores occurrence in the root zone of *Paepalanthus bromelioides* and *Bulbostylis* sp. (Pagano and Scotti 2009) and a high root colonization in native *Centrosema coriaceum* (Matias et al. 2009). Those rhizospheric sandy soils (sand >78%) presented low organic matter content (2.72%), low base saturation and P content and moderate acidity (pH 5.3) (Pagano and Scotti 2009). Eight AMF species were identified in the rhizosphere of the studied plants: *Acaulospora spinosa*, *A. elegans*, *A. foveata*, *Gigaspora margarita*, *Dentiscutata biornata*, *D. cerradensis*, *D. heterogama* and *Racocetra verrucosa*. The low number of AMF species reported

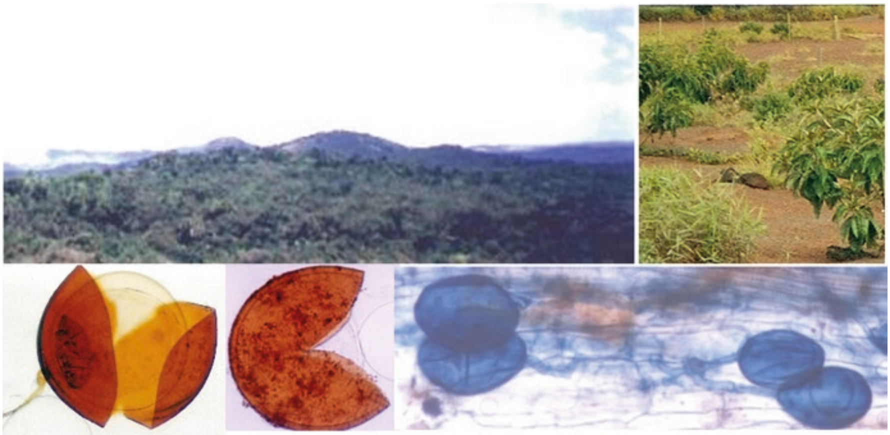

Fig. 9.2 Highland fields of Brazil. Clockwise, from upper left: native vegetation, colonized root by AM, and spores recovered from rhizospheric soils (photos by M. Pagano)

could be related to the small sample effort or the few plant species evaluated (Pagano and Scotti 2009).

Rupestrian ferruginous fields are characterized by soils of the iron mines region called Quadrilátero Ferrífero, in Minas Gerais State, and present small woody plants which support environmental stress (Rizzini 1997). In that areas a high percentage (90%) of root colonization was observed in preserved vegetation dominated by *Eremanthus incanus* (Pagano et al. 2010) (Fig. 9.2).

Teixeira et al. (2017) found 59 AMF species in an iron mining area in Minas Gerais State representing 15% of the 289 known species. These authors retrieved 57% of the AMF species by trap cultures and proposed this region as a hotspot of AMF diversity. Hotspots are priority places for AMF conservation, and besides the high diversity, they are threatened in the highest degree according to Myers et al. (2000).

Also in Minas Gerais, studies at "Parque Nacional das Sempre-Vivas", in Diamantina, revealed endangered plant species (*Syngonanthus elegans*) associated to 26 AMF species (Costa et al. 2016), which demonstrate the importance of mutualistic partners for plant establishment and survival.

New reports investigated the occurrence and density of AMF spores across different vegetation types in Bahia state, in the northeast region, showing that Glomeraceae and Acaulosporaceae were the most representative families in species number. The AMF community composition differ between habitats types, and the soil physical characteristics (silt and coarse sand) were the main factors related to the AMF community. A checklist of AMF in the Brazilian Cerrado was provided by Jobim et al. (2016) and on that a total of 92 species were reported; two of these species (*Ambispora brasiliensis* and *Cetraspora auronigra*) were exclusively found in rupestrian fields. These data indicate that more efforts should be made to investigate the diversity of AMF in areas of Cerrado, which is still little known regarding the occurrence of these soil fungi that probably also contribute for the establishment of vegetation and the ecosystem balance.

9.3 The Arbuscular Mycorrhizal Symbioses in Tropical Forest and Associated Ecosystems

Several studies were performed in areas of rainforest in Brazil, but most of them included sites of Atlantic rainforest, with less attention to the Amazonian rainforest, which probably also has a high diversity of AMF. Below we comment these studies, showing the need for further investigations.

9.3.1 The Arbuscular Mycorrhizal Symbioses in the Amazonian Rainforest

As mentioned, little consideration has been given to investigate mycorrhizal associations in the Amazonian rainforest (Stürmer and Siqueira 2006). However, as shown by Freitas et al. (2014), common AMF are widely dispersed in plant communities of this biome, where the spore density can attain nine spores per gram of dry soil and, interesting, circa 80% can be identified. In that study, 39 species were registered, with taxa of Glomeraceae dominating the AMF community. The highest number of species belonged to *Glomus* followed by *Acaulospora, Claroideoglomus* and *Scutellospora* (Freitas et al. 2014). Other research on Amazonian forest pointed to no alteration of species richness and abundance distribution across the conversion of pristine tropical forest to pastures (Leal et al. 2013). Other recent reports showed the decrease of AMF with the reduction of secondary forest cover in eastern Amazonia (Maia et al. 2015b) and AMF spore communities in the terra firme forest, a vegetation type from Central Amazonia (Freitas et al. 2014).

9.3.2 The Arbuscular Mycorrhizal Symbioses in the Atlantic Rainforest

In an updated review provided by Jobim et al. (2018), a total of 128 AMF species were registered in the Brazilian Atlantic Forest, and 18 of them, as well as one family and three genera, were first described from this biome, which is a hotspot of biodiversity.

In areas of Atlantic rainforest, 40 AMF species were associated with different vegetation types (Table 9.1), and these AMF communities were dominated by species belonging to the families Glomeraceae > Acaulosporaceae > Gigasporaceae.

Acaulospora and *Glomus* can be commonly found, accounting for 70–80% of the total spores recovered (Bonfim et al. 2013). In some rainforests in the South and Southeast of Brazil, AMF richness is lower at initial stages of the succession compared to mature forests although the number of spores can be greater at initial stages (Aidar et al. 2004; Stürmer et al. 2006; Zangaro et al. 2008). Recent studies conducted in a fragment of a seasonal semidecidual mountain forest in Vitória da Conquista, Bahia State, showed that the edge effect can modify the AMF communities with some exclusive species in the first 0–10 m from the edge (Santos et al. 2018).

In some areas of Atlantic rainforest, the spore density can attain ~20 spores per gram of dry soil, and ~72% can be identified by morphological methods; among 57 species identified from 79 spore types isolated from soil under different vegetational stages, Glomeraceae dominated the AMF community, and the highest number of species in mature forest belonged to *Glomus* and *Acaulospora* followed by *Claroideoglomus*, *Scutellospora* and *Gigaspora* (Zangaro et al. 2013). In that study, AM fungal community structure differed in 11 species along plant succession under Grass (43), Scrub (52), Secondary (41) and Mature forest (47 species). *Glomus* and *Acaulospora* predominated.

In other sites in Brazilian Atlantic forests, earlier studies also showed mean number of glomerospores from <1 to >10 spores g^{-1} soil (Aidar et al. 2004) and AMF richness of 13 (Silva et al. 2006) to 25 species (Aidar et al. 2004) in secondary forest and 14–27 species in riparian forests (Fernandes et al. 2016; Pagano and Cabello 2012).

Comparing areas of Atlantic Forest with different land uses, In Pernambuco State, Pereira et al. (2014) found 50 AMF species distributed in 15 genera; 52% of them belonged to *Acaulospora* and *Glomus.* These authors found that AMF community composition was more influenced by land use than by the physical and chemical soil characteristics and that "diversity, evenness, and richness indices tended to be lower in communities established in climax environments of Atlantic Forest, rather than in the ones established in cultivated areas".

The AMF in natural *Araucaria* forests, an ecosystem of Atlantic Forest occurring in the South and also in areas of the Southeast region of Brazil, was largely studied by the group of Elke Cardoso (University of São Paulo). In pioneer research by Moreira et al. (2003, 2006, 2007a, b, 2009) in the southeast of Brazil 18 AMF species of the genera *Glomus, Funneliformis, Rhizoglomus, Gigaspora, Acaulospora,* and *Archaeospora* were observed in the root zone of *A. angustifolia* (Moreira et al. 2016). They also found a rate of root colonization varying from 30 to 50%. *Acaulospora* and *Glomus* are very common in these forests, as previously reported (Moreira et al. 2007a, b, 2009). However, auxiliary cells (typical of Gigasporales) were also observed. The authors confirmed this plant species (*A. angustifolia*) as very AMF dependent for developing and survival, as trees that grow in relatively poor soil can obtain the nutrients necessary for growth and formation from AMF networks and, probably, by legumes that also fix nitrogen in their roots that grow in the forests (Cardoso and Vasconcellos 2015).

9.3.3 *The Mycorrhizal Symbioses in Sand Dunes, Restingas, and Mangroves*

In South America, studies on the AMF symbioses in Sand dunes and Restingas are concentrated in Brazil, with most reports from the States of Santa Catarina (Stürmer and Bellei 1994, 2011; Córdoba et al. 2001; Silva et al. 2017) and Rio Grande do Sul (Cordazzo and Stürmer 2007), in the South region; in São Paulo (Trufem 1995; Trufem et al. 1994), and Rio de Janeiro (Silva et al. 2017), in the Southeast region; in Paraíba (da Silva et al. 2012; Silva et al. 2015a, 2015b, 2017; Goto et al. 2009, 2010, 2012b; de Souza et al. 2013), Bahia (Santos et al. 1995; Goto et al. 2012b, Assis et al. 2016), and Rio Grande do Norte (Goto et al. 2012a, b; Błaszkowski et al. 2014, 2015; Silva et al. 2017) in the Northeast region.

In São Paulo State, a high number of glomerospores was observed in the rhizosphere of plants from the restinga da Ilha do Cardoso and this number increased with increasing temperature, precipitation and insolation (Trufem et al. 1994; Trufem 1995). The authors pointed out the dominance of *Acaulospora, Gigaspora* and *Scutellospora* over *Glomus* and *Sclerocystis.*

Stürmer's work in sand dunes improved the knowledge regarding native AMF communities in coastal ecosystems of South Brazil, being useful to be applied in conservation programs. His results confirmed the beneficial effects of AMF on dune stabilization (Stürmer and Siqueira 2006). In the coast of Santa Catarina, reports of Stürmer and Bellei (1994) showed the seasonal variation of AMF populations associated with *Spartina ciliata* in dunes, with four species being commonly retrieved: *Gigaspora albida*, *Racocetra weresubiae*, *Acaulospora scrobiculata* and *Scutellospora* sp. Twelve AMF species were recorded in Praia da Joaquina, and Gigasporales dominated in the fixed dunes whereas Acaulosporaceae dominated in the frontal dunes; the number of spores and species richness increased with dune stabilization (Córdoba et al. 2001). In Rio Grande do Sul, in contrast, Gigasporales dominated the fledgling dunes, while Glomeraceae dominated the fixed dunes with *Panicum racemosum* (Cordazzo and Stürmer 2007). *Racocetra weresubiae*, *Dentiscutata cerradensis* and *Racocetra gregaria* predominated in three areas of coastal dunes with similar AMF community structure (Stürmer et al. 2013).

The pioneer work on sand dunes from Northeastern Brazil (Bahia) was conducted by Santos et al. (1995), who reported that the majority of coastal dunes plants investigated were associated with arbuscular mycorrhiza, and *Glomus microcarpum* was the dominant species. Later, the research group led by LC Maia performed some studies on sand dunes and Restinga areas from Northeastern Brazil, mostly in Paraíba State. In these works, glomoid and gigasporoid spores were predominant both in natural and revegetated dunes (da Silva et al. 2012; Souza et al. 2013). Silva et al. (2015a) recorded 50 AMF species belonging to 18 genera in a vegetational gradient in dunes; higher AMF diversity was observed in herbaceous than in shrubby and arboreal dunes. These authors also found that pH, cation exchange capacity, Fe and fine sand were the main structuring factors of the AMF communities.

In studies along a transect crossing a fluvial-marine island, in short distances sites showing different edaphic characteristics and vegetation physiognomies (preserved mangrove forest, degraded mangrove forest, natural Restinga forest, and two regeneration Restinga forests) 22 AMF species were identified without differences in species richness. Conversely, spore abundance per family, diversity and composition of AMF communities and rate of mycorrhizal colonization differed statistically among the sites (Silva et al. 2017). These authors also mention that soil characteristics, especially the sum of exchangeable bases were strongly related to composition of AMF communities and that even within short distances the different habitat types host diverse AMF communities.

In Rio Grande do Norte state, Jobim and Goto (2016) recorded 46 AMF species distributed in 15 genera in maritime sand dunes of Brazilian northeast, while 24 AMF species were recorded by Silva et al. (2017) in dune areas from Rio Grande do Norte.

Several new species were described from sand dunes, such as *Racocetra tropicana* (Goto et al. 2011), *Paradentiscutata maritima* (Goto et al. 2012b), *Glomus trufemii* (Goto et al. 2012a), *Rhizoglomus natalensis* (Błaszkowski et al. 2014) and *Acaulospora ignota* (Błaszkowski et al. 2015), what indicates that these ecosystems are also of great interest for studies on diversity of AMF.

9.4 Conclusion

In this chapter, the occurrence of arbuscular mycorrhizas in different forest ecosystems has been compared. The diversity of AM fungi in different vegetation types was listed compiling recent results in dry forests, rainy forests, Cerrado (savanah) and rupestrian fields showing particular species composition. Three hotspots for AMF diversity were proposed: the Murundu fields, the Highland fields and the Rupestrian ferruginous fields. Besides, there are more challenges related to the need of improving the methodology of collection. Whitcomb and Stutz (2007) stressed the need of a higher sample effort (eg. from 30 to 75 samples) to deal with underestimated AMF diversity. Usually, to detect 70–80% of AMF species present in a community is difficult due to problems in quantifying the diversity and the complexity of AMF communities. These authors showed randomly distributed AMF species with no detectable belowground hotspots (associated to the location of plants). Thus, it is necessary to increase the sample efforts for detecting more species of AMF in natural communities. Morphological identification of AMF continues to be important, as well as molecular identification, considering that 11 to 40% of commonly present morphotypes continue to be unidentifiable.

Finally, this chapter shows that several natural ecosystems present high AMF diversity; with forests and Restingas (sand dunes) presenting high glomerospore richness. Further research is necessary, especially regarding the occurrence, identification and ecology of mycorrhizas for a better understanding of the Brazilian unique ecosystems.

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