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1. Introduction

Madagascar's flora is one of the world's richest, with tremendous numbers of species found nowhere else. Of its 10,000 to 12,000 plant species, 80% are endemic (including more than 1000 species of orchids). Nine plant families are found nowhere else in the world. Additionally, 90% of its 250 species of reptiles and 29 of its lemur species are unique to the island. It is estimated, however, that by 1925, close to 70% of the native forests that host this biodiversity had been felled for agricultural activities.

Most Malagasy farmers practice slash and burn agriculture on once forested upland soils. The high rates of deforestation and repeated burning are resulting in the rapid conversion of the last remnant fragments of rainforest to scrub forest and degraded lands dominated by introduced weeds such as *Lantana camara*, *Pteridium aquilinum* and *Imperata cylindrica*. The Malagasy subsist on a per capita income of around US\$ 200 per year and 700,000 ha of forest are still felled every year. Unless sustainable alternatives to slash and burn agriculture are made available to local farmers, it is likely that most remaining forests and their component species will be destroyed in the next 20 years.

As mycorrhizal fungi are important symbionts of many forest species and agricultural crops, identifying the native species of endomycorrhizal fungi will be an important step to develop resilient and productive food and fiber producing systems for Malagasy farmers. We were unable to find any published literature on endomycorrhizal fungi in Madagascar. This paper presents the first records of identified endomycorrhizal fungi in native forests and secondary vegetation of eastern Madagascar.

3. Objectives

- 1) To evaluate the impact of the loss of endemic plant species at the landscape scale on the diversity of native endomycorrhizal fungi.
- 2) To Characterize the host potential of vegetation following slash and burn agriculture along a gradient of increasing frequency of burning and soil degradation.

4. Hypotheses

We hypothesize that

- (1) the loss of endemic plant species results in a corresponding and significant loss of native endomycorrhizal fungi.
- (2) Given the low levels of available P (<1 mg/kg) in local soils, the lack of appropriate endomycorrhizal inoculum for native, successional plant species results in a dominance of invasive, exotic weed species that are less dependent on mycorrhizal fungi.

6. Results

Veg Class	Arbuscular Fungi	INVAM Ref. Accession
Primary forest	<i>Acaulospora spinosa</i> Walker and Trappe	WV861A
	<i>Acaulospora foveata</i> Trappe & Janos	BR861
	<i>Acaulospora koskei</i> Blaszkowski	PL116
	<i>Acaulospora morrowiae</i> Spain & Schenck	CL551
	<i>Entrophospora infrequens</i> (Hall) Ames & Schneider	AZ237
	<i>Gigaspora margarita</i> Becker & Hall	WV205A
	<i>Glomus clarum</i> Nicolson & Schenck	FL979A
<i>Trema orientalis</i> Tree fallow	<i>Scutellospora pellicuda</i> (Nicol. & Schenck) Walker & Sanders	FL966
	<i>Acaulospora koskei</i> Blaszkowski	PL116
	<i>Entrophospora infrequens</i> (Hall) Ames & Schneider	AZ237
<i>Psiadia altissima</i> Shrub fallow	<i>Acaulospora spinosa</i> Walker and Trappe	WV861A
	<i>Acaulospora morrowiae</i> Spain & Schenck	CL551
<i>Imperata cylindrica</i> Grass fallow	<i>Paraglomus occultum</i> (Walker) Morton & Redecker	CL700
	<i>Glomus clarum</i> Nicolson & Schenck	FL979A

8. Acknowledgements

We are most grateful to Dr. Joe Morton (INVAM) for providing access to INVAM facilities and expertise in matching our accessions with the INVAM reference collections. This study was made possible by funding from the Cornell International Institute for Food, Agriculture and Development (CIIFAD) and Landscape Development International (LDI/USAID).

2. Impact of Slash & Burn Agriculture on Landscapes in Madagascar



Slashing and burning of primary forests results in a rapid replacement of the native tree and shrub species with exotic, invasive species such as *Lantana camara*, *Pteridium aquilinum* and *Imperata cylindrica*. The above photo sequence from left to right, shows the establishment and dominance of the exotic weeds over a period of 5 - 6 years following the first slash and burn event in the primary forest.



With repeated slashing, burning and cultivation, large nutrient losses from the soil result in very poor vegetation cover and the exposed soil is rapidly eroded resulting in further loss of soil nutrients, soil organic matter, seed and spore pools. Often the eroded soils is deposited on fertile rice fields further reducing the productivity of productive fields and increasing slash and burn activities in the last remaining forest fragments on the island.

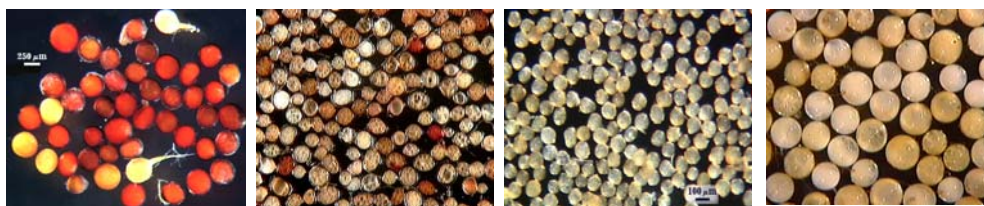
5. Methods and Data Collection

The experiment site is located on the east coast of Madagascar along the Mantadia – Zahamena rainforest corridor and is at an altitude of between 800-1200 m.a.s.l. The annual rainfall is between 1,800 to 2,100 mm and the soils are classified as Oxisols and Ultisols (US Soil Taxonomy). Soil pH is 4.9-6.1, available P <1 mg/kg, exchangeable Al 30-250 mg/kg.

We identified a vegetation gradient starting with primary rainforest and then a vegetation succession indicating increasing soil degradation. The species encountered with increasing degradation were *Trema orientalis*, *Harungana madagascariensis*, *Psiadia altissima*, *Rubus moluccana*, *Lantana camara*, *Aframomum angustifolium*, *Pteridium aquilinum*, *Stcherus flagellaris*, and *Imperata cylindrica*.

Soils were sampled in each vegetation category and analysed for soil chemical properties. Sub-samples were used to extract spores and establish pure cultures on Sudan grass as described in the INVAM protocols (<http://invam.caf.wvu.edu/methods.htm>).

Extracted spores were then compared against INVAM reference accessions with assistance from Dr. Joe Morton.



Synonymous with *A. foveata* BR861

Syn. with *G. clarum* FL979A

Syn. with *A. morrowiae* CL551

Syn. with *G. margarita* WV205A

7. Discussion & Future Studies

The results presented are based on a preliminary sampling of the pure cultures obtained with inoculum from different vegetation classes. There is a clear trend of a decline in the number of genera and species encountered on the more degraded sites. We are currently evaluating additional replicates from all vegetation classes to obtain a more robust estimate of the mycorrhizal diversity as impacted by loss of primary and native secondary woody vegetation on the east coast of Madagascar. We expect to find a significantly greater diversity of mycorrhizal fungi in the primary and native woody fallows than what we have encountered so far.

We were unable to find other published studies on mycorrhizal fungi in Madagascar. The accessions collected will be deposited in the INVAM collection and a duplicate collection will be established in Madagascar.

The next phase of this research will involve the use of mycorrhizal inoculum to help improve the establishment and survival of the key woody species being used to rehabilitate degraded upland sites. Our preliminary studies with local guano phosphate indicate a significant growth response in a variety of tree and crop plants such as rice, beans and ginger. The use of guano phosphate and appropriate mycorrhizal inoculum will most likely allow us to use a wider range of legume and non-legume species in the reforestation and re-vegetation of degraded uplands in eastern Madagascar.