



## Malagasy traditional treatments for food crops: A tool to control potato bacterial diseases?



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### ABSTRACT

The control and treatment of food crops bacterial diseases remain problematic due to a scarcity of effective phytotreatments. As traditional agricultural practices may represent an attractive venue to explore new treatments, Malagasy traditional practices were investigated for their effectiveness on potato plants. A survey was conducted among Malagasy farmers to collect information on diseases observed on potato crops and on traditional disease control practices. Twelve treatments against potato bacterial diseases were tested on two potato varieties, in experimental plots naturally infected by bacterial wilt disease. The information collected from 52 farmers (*i*) showed that leaf spots and bacterial wilt disease are the most frequently identified threats for potato crops; and (*ii*) allowed to identify 12 traditional treatments among which five exhibited protective properties on potato bacterial wilt disease. Moreover, one recipe (R07) was effective on the two potato varieties after two applications per week for 10 weeks, with 50% and 72% effectiveness rate, respectively. Valorization of traditional practices may provide an effective, safe, economic and standardized phytotreatment against potato bacterial wilt disease.

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### 1. Introduction

Food crops are economically very important in the developing world and represent an essential source of proteins in the diet of the poorest countries (FAO, 2013). In Madagascar notably, 90% of

the island central regions crop area are planted to food crops (UPDR, 2003a; UPDR, 2003b).

Food crops are attacked by insects as well as diseases with pathogens; potato crops appear as an attractive target (Horst, 2013b; Kirk et al., 2013; MAEP et al., 2001a; MAEP et al., 2001b). These diseases and insects cause major damages to field crops. Their control and treatment remain particularly problematic due to the scarcity of effective phytotreatments (Horst, 2013a); the major control options reside in crops rotation (Ahmed et al., 2012; Larkin, 2008; Umaerus, 1992), in the use of resistant varieties (AROPA et al., 2011; Fock et al., 2000) and in chemical disinfectants (e.g. hydrogen peroxide) (Arora and Khurama, 2004; Bojanowski et al., 2013). The available chemical treatments against insect attacks and fungal diseases are often costly and may pose risks to the ecosystem, farmers and consumers; Moreover, the water and soil can be contaminated by chemical residues

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<sup>1</sup> This article is dedicated to our close colleague and co-author, Jacob Philémon Rajaonarivelo, who died in September 2014.

(Giroux, 2003) and their accumulation threatening biodiversity (FAO and PAM, 2013).

Biological approaches so far mainly explored the control of insects (Dayan et al., 2009) with neem-based products (Ahmad et al., 2012), spinosads (Gentz et al., 2010), pyrethrins (Clark et al., 2013), rotenone insecticides (Lao et al., 2010), avermectins (Li et al., 2014), milbemycins (Wang et al., 2011), *Ryania speciosa* preparations (Omura, 2011), sabadilla, nicotine and essential oils (Rattan, 2010). Some natural products are also applied for plant pathogen management, including (i) in conventional cropping systems, actinomycetes antibiotics (Procopio et al., 2012) and chitin components (Senthilraja et al., 2010); and (ii) in organic agriculture, essential oils (Stevic et al., 2014) and extracts of giant knotweed (*Reynoutria sachalinensis* (F. Schmidt) Nakai) (Lalancette et al., 2013).

Further alternative methods based on biological products are certainly worth exploring to control and treat crop diseases (Narayanasamy, 2013). In Madagascar, the majority of farmers rely on both chemical products and traditional practices to solve their culture disease problems. These traditional practices, or “*ady gasy*”, are mostly mixtures of plant- and animal-origin materials, based on orally transmitted indigenous knowledge (VOARISOA and EZAKA, 1996).

The present survey has been conducted in 20 localities of two Madagascar farming regions (Analamanga and Vakinankaratra) to collect information on the diseases observed on potato crops and on the recourse to modern and/or traditional practices whenever diseases are detected. The effectiveness of recipes applied against bacterial diseases of potato has been tested in local experimental fields.

## 2. Methodology

### 2.1. Survey of traditional practices

#### 2.1.1. Survey area

The survey was carried out in two regions of Madagascar (Analamanga and Vakinankaratra regions) where food crops occupy 90% of growing area (UPDR, 2003a; UPDR, 2003b). Twenty localities were visited in seven districts (one in Analamanga region and six in Vakinankaratra region) (Fig. 1).

#### 2.1.2. Data collection and analysis

A survey of crop diseases and traditional treatment practices was carried out between July and December 2010 through interviews of farmers who are either members or leaders of their local farmer associations. The survey aimed to record the following data: (i) background information on the farmers, including name, age, address and GPS coordinates; (ii) general information about observed crop disease, including type of crop, observed symptoms, disease outcome and eventual identification; and (iii) chemical and/or traditional treatment(s) eventually applied, including composition, preparation, application mode and local availability of components. Relationships between data were graphed as interaction networks using the software Cytoscape 2.7.0 (<http://cytoscape.org>) with the layout organic (Mukazayire et al., 2011; Shannon et al., 2003). The survey was mainly focused on potato crops, however information about other crops (tomato and rice), was also collected. All data was reflected in the network but were not further explored in terms of treatments.

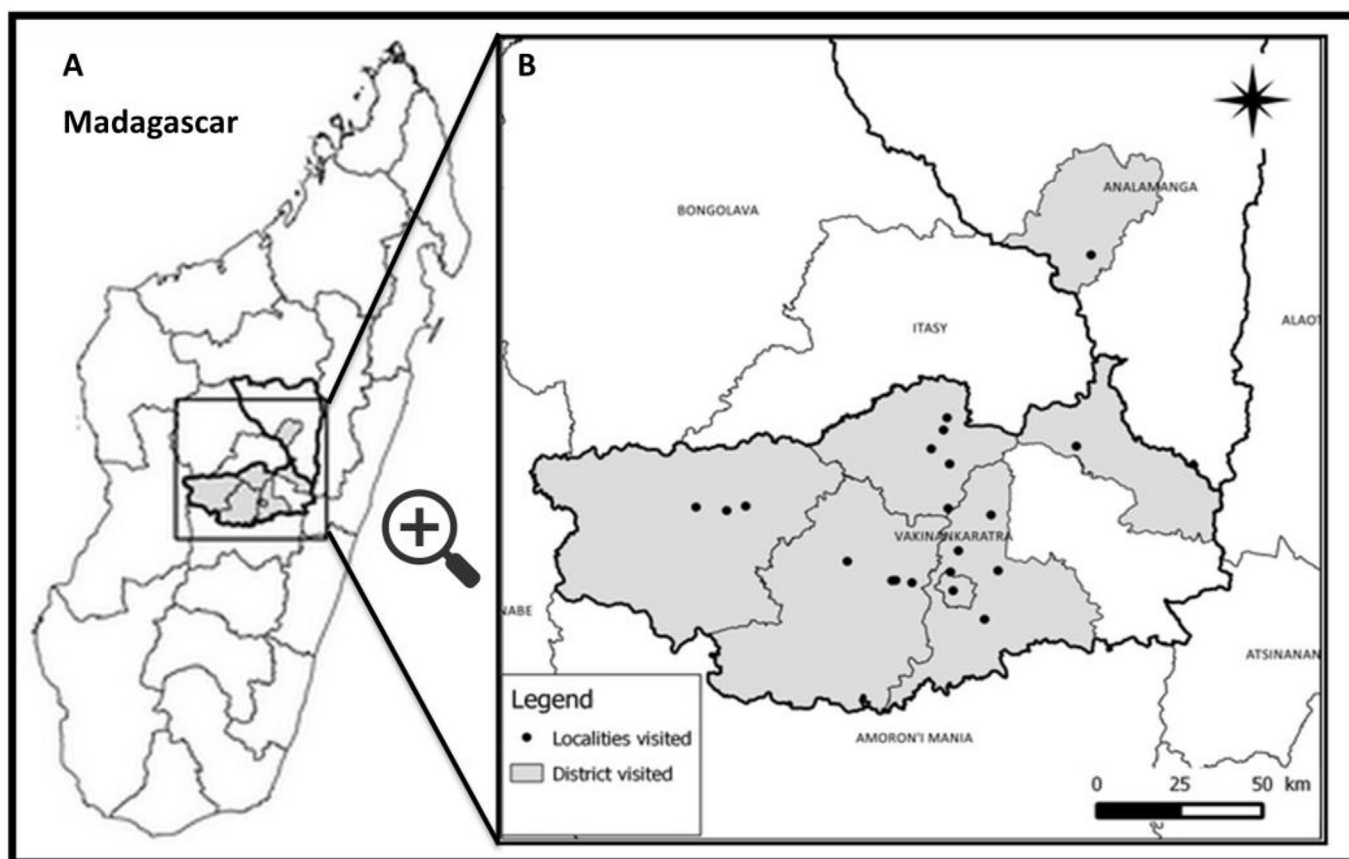


Fig. 1. Map of survey area with visited districts and localities. (A) Map of Madagascar, (B) Map of Vakinankaratra and Analamanga regions (grey color).

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