



Short communication

Soil *Bradyrhizobium* population response to invasion of a natural *Quercus suber* forest by the introduced nitrogen-fixing tree *Acacia mearnsii* in El Kala National Park, Algeria



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ABSTRACT

We analyzed the diversity and identity of the rhizobial populations nodulating an invasive Australian legume tree *Acacia mearnsii* in a natural *Quercus suber* forest in the El Kala National Park, Algeria. Soils from three different forest plots corresponding to non invaded original *Q. suber* stand, partially invaded by *A. mearnsii*, and totally invaded (monodominant) *A. mearnsii* stand were used to trap nodulating bacteria with the same tree species. Symbiotic nitrogen-fixing bacteria were isolated from root nodules and characterized by sequencing of the internal transcribed spacer region, then submitted to phylogenetic analyses. A total of 67 isolates was obtained, representing the 3 different forest plots, all renodulating *A. mearnsii* in monoxenic conditions. Phylogenetic analyses showed that all isolates belong to different *Bradyrhizobium* lineages, according to each of the three locations with little intermixing between forest plots. These results illustrate the adaptation of nodulating *Bradyrhizobium* populations to the new soil conditions induced by invasion. This symbiotic adaptability is presumed to be a key factor of the invasive character of this tree species.

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Black wattle (*Acacia mearnsii* De Wild.) is an Australia native species of the Fabaceae family that belongs to the subfamily Mimosoideae. Since the 19th century, *A. mearnsii* has been exported, as a source of tannin bark for leather industry, in Africa, Brazil and India. It is now distributed in many countries and considered invasive (<http://www.gisin.org/DH.php?WC=/WS/GISIN/home.html>). *A. mearnsii* is known to be nodulated by slow growing species of the genus *Bradyrhizobium* (Dreyfus and Dommergues, 1981; Turk and Keyser, 1992; Lafay and Burdon, 2001).

In Algeria, the El Kala National Park was created in 1983 and recognized as a Biosphere Reserve by the UNESCO in 1990. The area is known for its rich biodiversity. Among forest ecosystems are *Quercus suber* stands that are threatened by invading *A. mearnsii* spontaneously colonizing these stands from old eucalypts-*A. mearnsii* mixed plantations. The progressive settlement of *A. mearnsii* has a dramatic effect on the initial *Q. suber* stands, leading to the irreversible disappearance of *Q. suber* and its natural

floristic associates, ending in almost pure stands of *A. mearnsii*. In a preceding work, we showed that this invasion had a strong deleterious effect on soil chemical characteristics, on soil microbial functions and ectomycorrhizal communities associated to the early growth capacities of *Q. suber* seedlings (Boudiaf et al., 2013). In this work, we aim at understanding how this *A. mearnsii* deals with its nitrogen fixing symbiotic partners from soils taken along an invasiveness gradient, from a natural *Q. suber* stand to a partially invaded one and then to a pure spontaneous stand of *A. mearnsii*.

The experimental area, soils sampling and characteristics were fully described in Boudiaf et al. (2013). Briefly, they consisted of pooled soil samples taken along an invasiveness gradient, from a natural *Q. suber* stand (S1) to a partially and spontaneously invaded one (S2) and then to a pure and also spontaneous stand of *A. mearnsii* (S3). To our knowledge, no rhizobial inoculation of any tree has ever been made in the whole area. The soil samples (S1, S2 and S3) were used to obtain *A. mearnsii* – nodulating rhizobia by soil trapping. Young seedlings of *A. mearnsii*, germinated in agar plates, were inoculated with 60 g of soil in top of a pot filled with sterile sand-loam and grown in Mediterranean greenhouse with 5 replicates of 2 plants for each soil. After plant nodulation, 12

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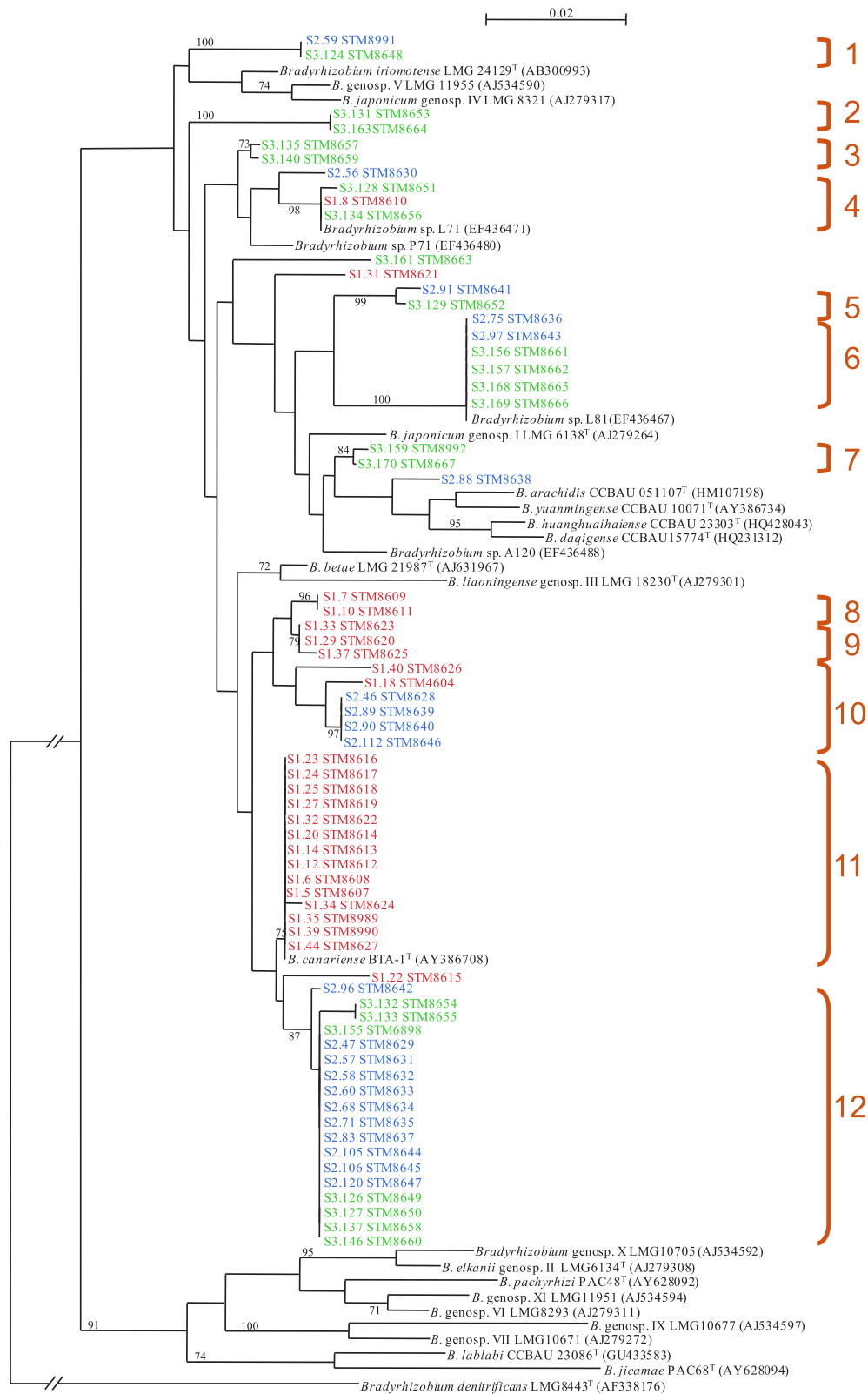


Fig. 1. Phylogenetic tree based on analysis of partial ITS sequences of 67 *Acacia mearnsii* isolates and related bradyrhizobia strains, determined by using the neighbor-joining method and rooted with *Bradyrhizobium denitrificans*. Numerical values at the branching points are the bootstrap values of 100 replications. Only bootstrap values higher than 70% are given. The database accession numbers are indicated in parentheses. The type strains are indicated with the character "T". S1: natural *Quercus suber* stand, S2: mixed (invaded) *Q. suber*/*Acacia mearnsii* stand, S3: pure, totally invaded, *A. mearnsii* stand.

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