British Mycological Society promoting fungal science

journal homepage: www.elsevier.com/locate/funbio

Assimilation of organic and inorganic nutrients by *Erica* root fungi from the fynbos ecosystem

*Christine BIZABANI, Joanna Felicity DAMES**

Department of Biochemistry and Microbiology, Rhodes University, P.O. Box 94, Grahamstown, 6140, South Africa

ARTICLE INFO

Article history:
Received 1 July 2015
Received in revised form
10 November 2015
Accepted 17 November 2015
Available online 26 November 2015
Corresponding Editor:
John Dighton

Keywords:
Albany Centre of Endemism
Dark septate endophytes
Ecological function
Enzyme activity
Ericoid mycorrhizal fungi
Nutrient assimilation

ABSTRACT

Erica dominate the fynbos ecosystem, which is characterized by acidic soils that are rich in organic matter. The ericaceae associate with ericoid mycorrhizal (ERM) fungi for survival. In this study fungal biomass accumulation *in vitro* was used to determine nutrient utilisation of various inorganic and organic substrates. This is an initial step towards establishment of the ecological roles of typical ERM fungi and other root fungi associated with *Erica* plants, with regard to host nutrition. *Meliniomyces* sp., *Acremonium implicatum*, *Leohumicola* sp., *Cryptosporiopsis erica*, *Oidiodendron maius* and an unidentified Helotiales fungus were selected from fungi previously isolated and identified from *Erica* roots. Sole nitrogen sources ammonium, nitrate, arginine and Bovine Serum Albumin (BSA) were tested. *Meliniomyces* and *Leohumicola* species were able to utilise BSA effectively. Phosphorus nutrition was tested using orthophosphate, sodium inositol hexaphosphate and DNA. Most isolates preferred orthophosphate. *Meliniomyces* sp. and *A. implicatum* were able to accumulate significant biomass using DNA. Carbon utilisation was tested using glucose, cellobiose, carboxymethylcellulose, pectin and tannic acid substrates. All fungal isolates produced high biomass on glucose and cellobiose. The ability to utilize organic nutrient sources in culture, illustrates their potential role of these fungi in host nutrition in the fynbos ecosystem.

Introduction

Ericoid mycorrhizal (ERM) fungi play a vital role in the success of ericaceous plants in ecological regions that are characterised by harsh edaphic growth conditions (Cairney & Meharg 2003). A well-known example is the fynbos biome in South Africa. It is characterised by acidic soil conditions that are rich in recalcitrant organic matter but low in available nitrogen and phosphorus. Yet, it is a hot spot of *Erica* plant diversity. *Erica* roots are associated with established beneficial fungi such as ericoid mycorrhizal fungi, dark septate endophytes and numerous other fungal taxa contributing to the individual success of the genus *Erica* in this ecosystem.

Several beneficial root fungi may co-occur in the host roots, and some can be cultured. This allows studies to be conducted on their abilities to degrade organic polymers such as chitin, protein, nucleic acids and lignin (Cairney & Burke 1998). Culture-based and field studies have confirmed the saprotrophic capabilities of numerous ERM fungi (Cairney & Meharg 2003). These secrete enzymes and secondary metabolites that unlock organic complexes. This releases simple mineral nutrients that can easily be utilised by the host plant. For

* *Corresponding author*. Tel.: +27 0 46 603 8443; +27 0 83 636 0706 (mob).
E-mail address: J.dames@ru.ac.za (J. F. Dames).
http://dx.doi.org/10.1016/j.funbio.2015.11.006

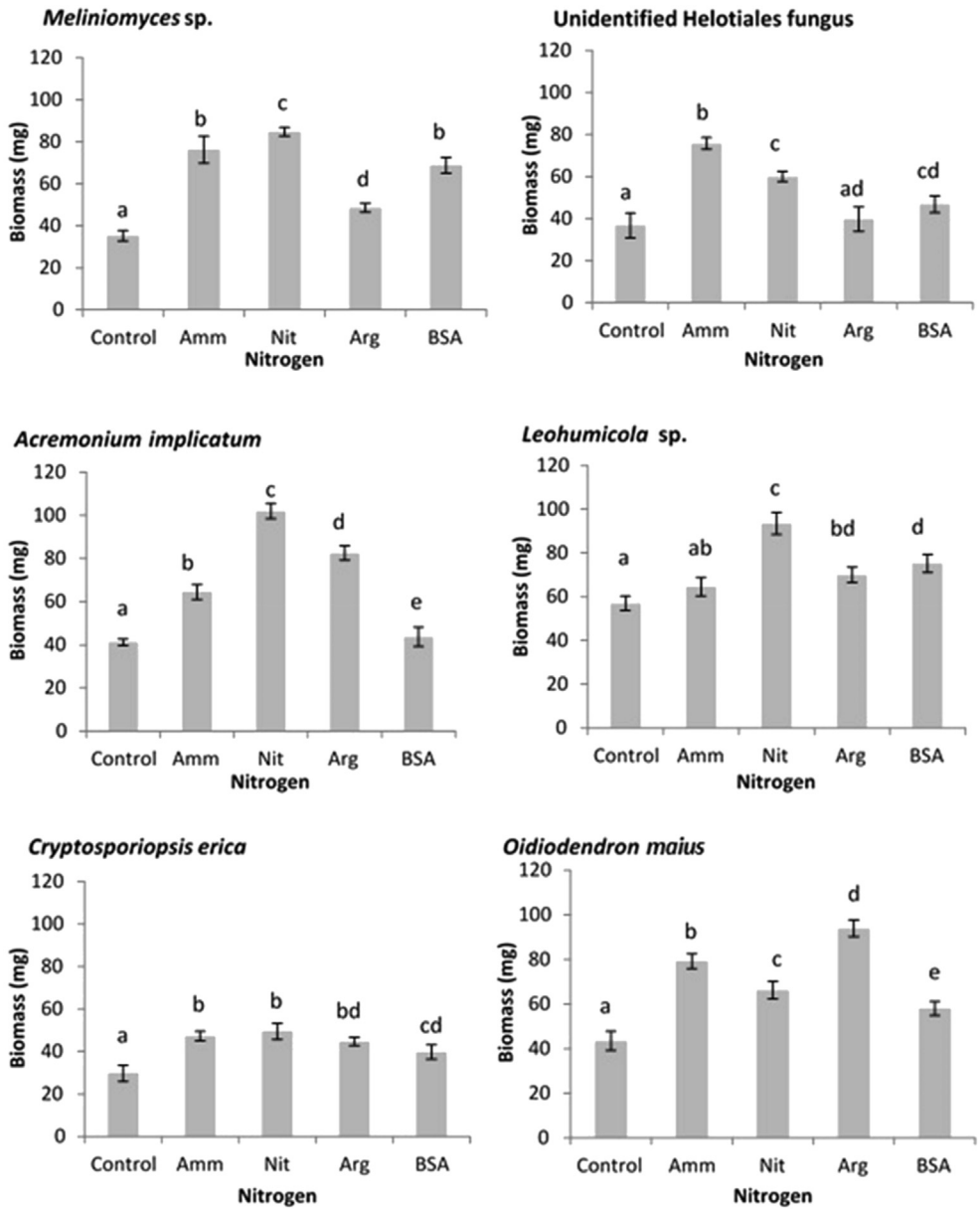

Fig 1 – Mean (±standard error) biomass production of six ericaceous fungal isolates grown for 21 d in four different N sources. Letters above columns indicate significant differences ($p < 0.05$, N = 4). Treatments were Control (no N), Ammonium (Amm), Nitrate (Nit), Arginine (Arg), and Bovine Serum Albumin (BSA).

example, *Rhyzoscyphus erica* was able to utilise various organic sources of N such as amino acids, peptides, and proteins in culture (Cairney *et al.* 2000). To confirm its ecological role of enhancing N assimilation by the host, *R. erica* inoculated *Gaultheria shallon* plants utilised organic N sources glutamine, glutathione and BSA, whereas non-inoculated plants did not utilise any of these substrates (Xiao & Berch 1999). Such techniques have been successfully used in determining the roles of ERM fungi (Chambers *et al.* 2000).

There are numerous root fungi associated with *Erica* plants whose ecological roles have not been researched. Most functional roles of Ericaceae associated fungi have been extensively researched for *R. Erica* (Vrålstad *et al.*, 2002; Vohník *et al.* 2005; Smith & Read 2008), which is absent in the fynbos of South Africa (Bizabani 2015). Hence, there is a need to conduct studies that establish the ecological functional roles of the *Erica* root fungus with regard to nutrient utilisation. This can primarily be tested by examining their nutrient acquisition patterns in culture media amended with specific organic nutrients. The aim of this study was to assess the ability of selected ericaceous fungi to utilise various inorganic and organic sources of N, P, and C using biomass accumulation in liquid culture.

Methods

The fungal isolates used in this study were *Meliniomyces* sp. (Hambl. & Sigler) (Isolate code ECRU075/GenBank accession