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Microbial consortia inoculation of woody legume *Erythrina brucei* increases nodulation and shoot nitrogen and phosphorus under greenhouse conditions

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ABSTRACT

The legume-rhizobium symbiosis provides Nitrogen (N), while Legume-AMF symbiosis improves Phosphorus (P) supply to plants. This research was conducted to evaluate the symbiotic effectiveness of the Bradyrhizobium spp. and consortial inoculation of plant growth promoting bacteria -*Bradyrhizobium shewense* (AU27) and *Acinetobacter soli* (AU4), and arbuscular mycorrhizhal fungi *Glomus* sp.1 (AMF1) and *Acaulospora* sp.1 (AMF2), on growth, production and shoot N and P content of *Erythrina brucei*.The bacterial and mycorrhizal species were evaluated for phyto-beneficial properties in the greenhouse as individual as well as consortial inoculation.. All Bradyrhizobium species were effective for symbiotic nitrogen fixation. Consortial inoculations comprising of *B. shewense* (AU27) + *A. soli* (AU4) + *Glomus* sp.1 (AMF1) + *Acaulospora* sp.1 (AMF2) (T7) increased shoot length and shoot dry weight by 140% and 268%, respectively compared to un-inoculated control. Inoculations that involved *B. shewense* (AU27) + *A. soli* (AU4) increased shoot nitrogen by 260%, and 1200% increment of shoot P was recorded with inoculations of *B. shewense* (AU27) + *Glomus* sp.1 (AMF1) compared to un-inoculated control. These microbial inputs could be candidates for growth enhancement and shoot nitrogen and phosphorus improvement in *Erythrina brucei* and also as sustainable and eco-friendly agriculture input.

1. Introduction

Nitrogen (N), phosphorous (P) and Potassium (K) are the three most important nutrients that determine soil fertility and limit plant growth. However, it is established that plant growth and health is not only determined by the availability of these nutrients, but also by the presence of consortium of microorganisms in the vicinity of the root surface known as the rhizosphere. About 2-5% of the rhizosphere competitive microbes exert phyto-beneficial effects. The use of plant growth-promoting microbes (PGPM) is a potentially advantageous technique for improving crop productivity, food quality and security in more sustainable and eco-friendly agricultural systems [2, 14, 24]. These microorganisms are engaged in symbiotic relationships with a multitude of above- and belowground plant parts that constitute phyto-beneficial microbes, including rhizobia, mycorrhizal fungi, and endophytes [34].

Rhizosphere associated bacteria referred to as rhizobacteria and the Mycorrhizha majorly contribute to plant growth promoting functions. Somers et al. [38] have classified these rhizosphere associated microorganisms based on their roles as (i) biofertilizers (increasing the availability of nutrients to plant), (ii) phytostimulators (plant growth promotion, generally through phytohormones production), (iii) rhizoremediators (degrading organic pollutants) and (iv) biopesticides (controlling diseases, mainly by the production of antibiotics, antifungal metabolites, synthesis of fungal cell wall and its component degrading enzymes). Plant growth promoting rhizobacteria have the potential to produce different types of metabolites that help the host plants to improve minerals such as phosphorus and iron, promote growth and protect them from phytopathogens, and enhance their tolerance to abiotic stresses [3, 32].

The symbiotic association between leguminous plants and rhizobium

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