SIDEROPHORES PRODUCTION AND ANTAGONISTIC BEHAVIOUR OF RHIZOSPHERIC MICROORGANISMS IN RELATION TO IRON AVAILABILITY

ABSTRACT

Variable magnitudes of siderophores production were qualitatively and quantitatively determined amongst 64 representatives of four groups of rhizospheric microorganisms. Generally, fluorescent pseudomonads and phytopathogenic fungi were effective siderophores producers as compared with soybean root nodulators. Azotobacters, as asymbiotic N_2- fixers, appeared to occupy an intermediate rank. While all bacterial representatives produced catechol type siderophores, the phytopathogenic fungi produced the hydroxamate type. In iron limited media, no antagonism was reported between root nodule bacteria or azotobacters and phytopathogenic fungi. The phenomenon was particularly associated with fluorescent pseudomonads but was affected by the composition of culture medium and tested organisms. While available iron generally enhanced the growth of *Ps. fluorescens* and phytopathogenic fungal strains, their siderophores production capacities were concomitantly retarded. SDS-PAGE analysis showed that high levels of available Fe (5 and 10 mg Fe-EDTA / ml medium) repressed the expression of 4 protein bands in *Ps. fluorescens* B outer membrane which were disinctly observed in cells grown in iron starved medium. Available iron also induced variable degrees of reduction in antagonistic activities of fluorescent pseudomonads against phytopathogenic fungi or root nodule bacteria.

Keywords: Siderophores, Fluorescent pseudomonads, N_2-fixers, Phytopathogenic fungi, Iron availability, Relative power of antibiosis

INTRODUCTION

Iron is an essential nutrient for all living cells. It is the fourth most abundant element in the Earth's Crust. However, under aerobic conditions and neutral pH, ferrous ions are converted to their oxidized forms, which tend to form highly insoluble ferric hydroxides that are unavailable to living organisms **(Barash, 1990)**. Under iron limited condition, microorganisms evolved high-affinity systems mediated by siderophores (Greek for "iron-bearers"), which are low-molecular weight (0.5 to 1.5 KDa), highly specific Fe^{+3} chelating agents. Many studies have examined the chemistry and kinetics of iron transport by siderophores **(Neilands, 1995 and Terano *et al.* 2002)**, but the role of siderophores in competition for iron in plant / microbe and microbe / microbe interactions is receiving increased attentions **(Bhattarai and Prasad 2003)**.

Systems such as siderophores, involved in the acquisition of iron under iron-limited conditions, may play a role in microbial interactions. Many rhizosphere *Pseudomonas* species are plant-pathogenic, but it has been shown that some pseudomonads promote plant growth **(Kloepper *et al.* 1980 and Manwar *et al.* 2000)**, and inhibit pathogenic bacteria and fungi **(Manwar *et al.*, 2000)** by producing siderophores. Siderophore production by many *Pseudomonas* species has been clearly demonstrated in the control of phytopathogenic fungi **(Goel *et al.* 2000 and Manwar**