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Reciprocal interactions between plants and fluorescent pseudomonads in relation with iron in the rhizosphere

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INTRODUCTION

Iron is an essential element for plants and microbes. Iron competition was demonstrated to be an important driver of the interactions between fluorescent pseudomonads and the rhizospheric microflora (Lemanceau et al., in press). To face this competition, plants and microorganisms have developed active strategies of iron uptake. In non graminaceous plants (strategy I), iron uptake relies on acidification and reduction of Fe(III) to Fe(II) which is incorporated into the roots by iron transporters (eg. IRT1). Active iron uptake by microorganisms relies on siderophores showing high affinity for iron.

We have previously shown that plants of Arabidopsis thaliana (strategy I) supplemented with Fe-pyoverdine had (i) a higher iron content than those supplemented with Fe-EDTA, (ii) iron incorporation from pyoverdine did not involve IRT1, and (iii) 57-N-labeled pyoverdine was incorporated into plants (Vansuyt et al., 2007). Taken together, these observations suggest that iron from Fe-pyoverdine was incorporated into plants not through the strategy I. In the present study, we explored possible mechanisms for incorporation of iron from pyoverdine at the cellular level.

RESULTS

Fe-pyoverdine localization in root

Confocal sections of root labeled with pyoverdine antibody clearly indicated pyoverdine presence in plants. Immunolocalization revealed the presence of pyoverdine in the root apoplasmic space.

Observations and quantification with TEM showed a more abundant presence of vesicles in the root apoplasm of plants when cultured with Fe-pyoverdine than with Fe-EDTA. However pyoverdine immunolabeling of root sections was not sensitive enough to allow the possible detection of pyoverdine in the vesicles. Altogether, these data confirm the acquisition of iron from Fe-pyoverdine by A. thaliana and suggest that iron incorporation from Fe-pyoverdine could be related to endocytosis. Further experimental proof is required to determine if the increase of vesicles in the presence of pyoverdine mediates that process.

CONCLUSION

In vitro culture of Arabidopsis plants

Plants cultured for seven days without any iron supplementation and for seven more days after having been supplemented with Fe-pyoverdine or Fe-EDTA or not supplemented

Sampling of 14-day old roots for ultrastructural studies with transmission electron microscopy (TEM) and immunolocalization of pyoverdine in roots by confocal microscopy and TEM

Fe-pyoverdine localization in root

Fe-EDTA Fe-Pyoverdine

Incorporation of Fe-pyoverdine by endocytosis?

Monitoring endocytosis by uptake of the endocytosis marker FM-4-64 might indicate that incorporation of Fe-pyoverdine relies on endocytosis.

Quantification of apoplasmic vesicles in root cells

For each sectioned cell, apoplasmic vesicles (AVs) were classified into three classes and results are expressed in percentage of cells exhibiting 1,2-5 and >5 AVs per cell.

Microscopy Conference 2009, Graz, Austria – 30 August -4 September 2009

References

