Multi-species inoculants with desiccation-resistant bacteria for growth stimulation of *Echinocactus platyacanthus*

Julia María Alatorre-Cruz[1], María del Rocío Bustillos-Cristales, Héctor Gutiérrez-Sánchez, Yolanda Elizabeth Morales-García, Rebeca Débora Martínez-Contreras and Jesús Muñoz-Rojas*.
Laboratorio de Ecología Molecular Microbiana, CICM-ICBUAP, Edf. 103 J, C. U., San Manuel, Puebla C.P. 72570.
e-mail:[1] julia_alatorre@yahoo.com.mx; *Corresponding author: joymerre@yahoo.com.mx

Key words: Cactus, Plant growth promoting bacteria.

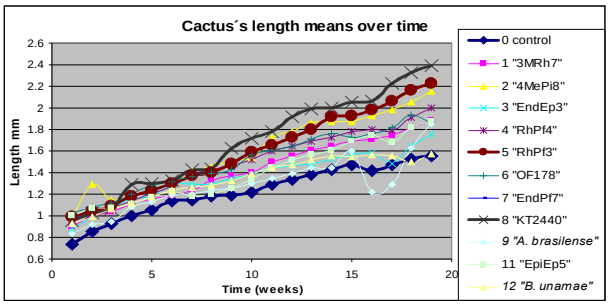
Introduction. Cactus are important ecological plants in the arid zone, because they avoid erosion, maintain microbial populations and biodiversity of others organisms. *Echinocactus platyacanthus*, also known as "biznaga" or "acitron", is an endemic globose cactus from Mexico. The growth of this plant is very slow, taking about 200-500 years to reach maturity. *E. platyacanthus* has many uses, and it can be exploited as food, for traditional consumption and with ornamental purposes, among others. However, these practices produce a big problem because the cactus population has diminished and it is currently threatened (NOM-059-SEMARNAT-2010). Consequently *E. platyacanthus* has been protected in the Tehuacán-Cuicatlán Biosphere Reserve, located within the Mixteca Oaxaqueña Province, between the cities of Puebla and Orizaba, in México.

A biological inoculant is a mixture of microorganisms that could have a particular beneficial function in plants, mainly growth promotion (1)The aim of the present work was to discover bacterial strains that could be both growth promoters and desiccation resistant, with the capability to promote the growth of *E. platyacanthus*. Bacteria with desirable features were explored as mixed inoculants.

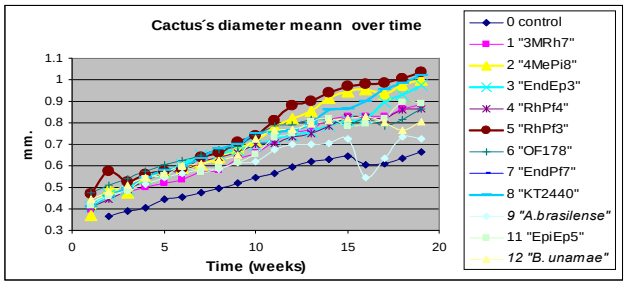
Materials and methods. Simultaneous inhibition and double agar layer antagonism methods were used to select compatible bacteria with the ability to produce inhibitory substances (23 strains). Desiccation experiments (2) were performed to select the most resistant bacteria. Independent and combined inoculation assays were carried out in *E. platyacanthus*. Plants were grown in sterile vermiculite watered whit MS solution in 500 ml pots within a plant tissue culture chamber. Parameters as length and diameter of cactus were used to evaluate the growth promotion. Ordinal least squares regression model (OLS) was used to compare the data.

Results. *Pseudomonas putida* KT2440, *Sphingomonas* sp. OF178, *Burkholderia unamae* MTl-641, *Azospirillum brasilense*, and some methylotrophic strains (Rhpf3, EndEp3, Endpf7 EpiEp5, Rhpf4, 4Mepi8, 3MRh7), were resistant to desiccation and they could coexist because no antagonism was observed (data not shown). Bacterial strains with tendency to stimulate the growth of cactus plants according to the OLS´s model were *P. putida* KT2440 UAPS01203 (4MePi8), UAPS01200 (RhPf3) ($p \leq 0.001$) and the strain that changed the intercept was *Sphingomonas* sp. OF178 ($p \leq 0.001$).

The best combination included *P. putida* KT2440, UAPS01203 (4MePi8) and UAPS01200 (RhPf3), resulting in a significant accelerated growth of *E. platyacanthus*.

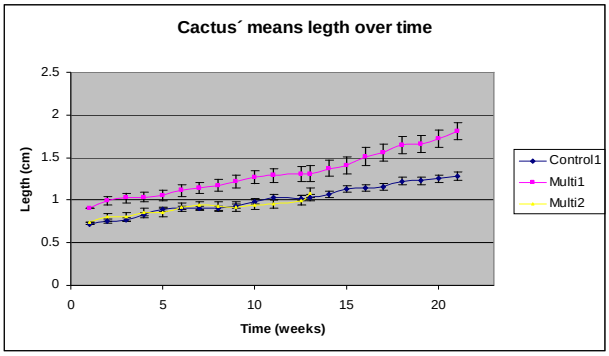


Graphic 1.



Graphic 2

Graphics 1 and 2 show cactus growth (length in 1 and diameters in 2) at 20 weeks after independent bacteria inoculation. Respective controls (non-inoculated) were included.



Graphic 3. Cactus growth (Length) of 2 mixed inoculants Multi1 (UAPS01200 (Rhpf3), UAPS01203 (4Mepi8), KT2440, OF178) and Multi2 (*B. unamae,* Rhpf4, 4Mepi8).

Bibliography.

1. Morales-García Y, Juárez-Hernández D., Aragón-Hernández C., Mascarua-Esparza A., Bustillos-Cristales M., Fuentes-Ramírez L., Martínez-Contreras R., Muñoz-Rojas J. 2011. *Rev Arg Microbiol* (43) 287-29.

2. Muñoz-Arenas L., Morales-García Y. 2006. *V Encuentro Nacional de Biotecnología del IPN. México, DF*, 50-54.