

Beneficial Bacteria from the Olive Rhizosphere Promote Growth of Sunflower Plants and Reduce Infection by *Orobanche cumana*

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Abstract

Contrarily to oilseed sunflower, in which genetic resistance provides effective control of *Orobanche cumana* Wallr. (broomrape), confectionary sunflower is highly susceptible to the holoparasite. Until breeding programs succeed in incorporating resistance into commercial hybrids of confectionary sunflower, other alternatives must be considered for the control of *O. cumana*. Biological control agents (BCA), alone or in combination with other measures, constitute an eco-friendly alternative in the management of crop diseases. Some *Pseudomonas* spp. strains do not only display *in vitro* growth inhibition of different crop pathogens, but they are also able to suppress their deleterious effects in plants. Selected strains of *P. fluorescens* and *P. putida* have been demonstrated as effective BCA against *Verticillium dahliae* affecting olive trees. Moreover, the ability of strain *P. fluorescens* PICF7 to colonize the roots of sunflower has been previously reported by our research group. Other BCA effective in disease suppression are *Bacillales* members such as *Paenibacillus* spp. or *Bacillus* spp. The objectives of this work were: a) to assess whether bacterial BCA had any (beneficial or detrimental) effect on the growth of sunflower; and b) to analyse the potential of some *Pseudomonas* spp. and *Bacillales* strains as BCA against broomrape of sunflower. Two experiments were conducted in the greenhouse at 22–28°C and 14-h light photoperiod for 5 weeks. In the first experiment seeds of the confectionary sunflower B117 were germinated and bacterized with suspensions of six *Pseudomonas* spp. strains and three *Bacillales* strains. Water and MgSO₄ treatments were included as controls. Eight seedlings (replications) were planted into 250-g pots. The

same number of replications was used in the second experiment, in which bacterized B117 seedlings were individually transferred into 250-g pots containing a sand:silt:peat moss mixture uniformly infested with 10 mg of parasite seeds (Oc01-15 population of *O. cumana*). Results showed that among *Bacillales* representatives, *Paenibacillus polymyxa* PIC73 significantly decreased the height of sunflower. On the contrary, the beneficial effect of *P. fluorescens* PICF6 was evidenced by significantly higher weights of above-ground plant biomass upon bacterization. Remarkably, presence of *Pseudomonas indica* PIC25 resulted in a significant reduction of the number of broomrape nodules in sunflower. These results are currently being confirmed in experiments in the greenhouse, as well as the effect of novel bacterial BCA on both sunflower growth and *O. cumana* infection in the plants.

Supported by grant P12-AGR-667 (Junta de Andalucía, Spain), co-financed by ERDF from the EU.

Key Words: Biological control, *Helianthus annuus* L., *Paenibacillus* spp., Plant growth promotion, *Pseudomonas* spp.

橄榄根际有益细菌促进向日葵植株的生长减少列当的侵染

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摘要

油用向日葵的遗传背景能够有效地抗列当，相反，食用向日葵对列当表现为高感。在能够成功将列当抗性基因转入食用向日葵商品杂交种之前，必需有替的方法来控制列当。单独使用生物控制剂（BCA）或与其它措施结合使用是防治病害中有利于生态的选择。一些假单胞菌属菌株不仅在体外对不同作物致病菌的生长表现出抑制作用，而且能够抑制它们对植株的有害影响。已经证明所选菌株 *P. fluorescens* 和 *P. putida* 是橄榄树黄萎病菌的有效生物控制剂。此外，我们以前的研究也表明 *P. fluorescens* PICF7 菌株能够在向日葵的根系生长。其它的对病害起有效抑制作用的生物控制剂是芽孢杆菌目，如类芽孢杆菌和芽孢杆菌。本研究的目标有：a) 评价细菌的生物控制剂对向日葵的生长作用（有益的和有害的）；b) 分析一些假单胞菌属和芽孢杆菌目菌株作为向日葵列当生物控制剂的潜在可能性。两个实验均在温室中 22–28°C 和 14h 光周期下持续 5 周。第一个实验中，食用向日葵 B117 的种子发芽并在 6 个假单胞菌属菌株和 3 个芽孢杆菌目菌株的悬浮液中生长。水和 MgSO₄ 处理作为对照。8 株幼苗（重复）种植在 250g 的花盆中。第二个实验的重复数同第一个实验，将菌液中的 B117 幼苗单独转移到沙子：泥沙：泥炭均匀混合基质并含有 10mg 列当种子的 250g 花盆中。结果表明，在芽孢杆菌目中，多粘类芽孢杆菌（*Paenibacillus polymyxa*）PIC73 导致向日葵的植株显著降低。相反，*P. fluorescens* PICF6 由于菌液的作用使得植物地上部的生物量显著提高。尤其明显的是，假单胞菌属 *indica* PIC25 的存在显著降低了向日葵列当的结瘤数。上述结果及新的细菌生物控制剂对向日葵生长和列当侵染的作用正在进行温室实验的验证。

关键词：生物防治，向日葵，类芽孢杆菌，假单胞菌，植物生长，列当