Paraburkholderia sp. SOS3

Description, Features and Delivery Mechanisms

Summary

Genus: *Paraburkholderia*

Strain: SOS3

Forming spores: No

Type: Aerobic

Relationships to plants: Mutualistic

Suitability: Wide range of crops incl. corn, sorghum, rice, sugarcane, pine, avocado, macadamia, tomato

Beneficial effects on plants: Enhance seedling vigour (germination rate, seedling growth), nutrient uptake, root and shoot biomass, and resistance to biotic stress.

Application method(-s): Traditional seed treatment, soil application on a mineral carrier and encapsulation, or in blends with fertilisers.

Compatibility: Broadacre, horticulture, greenhouse hydroponics

Features: Bio protection, nitrogen fixation, organic phosphate solubilisation, and siderophore production

Beneficial characteristics description

SOS3 creates biofilm on the surface of the roots inducing an anaerobic environment that is suitable for biological N2 fixation (BNF). *SOS3* in rhizosphere activates a broad panel of energy pathways that generate energy production in every scenario, both aerobic and anaerobic (facultative anaerobic bacterium). As a result, in the biofilm the bacterium experience the energy-rich and oxygen-depleted environment required for BNF.

In response to this microaerobic condition, the host plant creates large aerenchyma to facilitate O2 passage and for the plant and bacterial respiration — large aerenchyma also results in bigger roots facilitating better nutrient acquisition.

Direct transportation of nitrogen during nitrogen fixation process into the root system is highly efficient comparing to other microorganisms and allows to reduce artificial nitrogen application (fertiliser) from 10 to 30% depending on the plant. Some commercial trials (for ex. tomato) demonstrate an increase in yield even if nitrogen fertiliser rates are decreased by 40%.

SOS3 can solubilise organic phosphate deposits presented in soil (either naturally created or added as a part of organic matter/fertiliser) in the form of insoluble phytate. It is found that phytate can be used as phosphorus source for the plant at the condition that the plant has been inoculated with *SOS3*. The plant itself is unable to use phytate.

During glasshouse and field trials it was found that *SOS3* demonstrates strong bio protection capabilities against some well-known pathogens. It was decided to conduct clean laboratory

experiments to confirm trials' data. To date, Prince of Songkla University research shows *SOS3*'s ability to suppress *Fusarium moniliforme*, *Helminthosporium oryzae* and others. This experiment is continuing in 2020 to test protection against other diseases.

Sugarcane field trial at Mitr Phol Research Station (Thailand) conducted in 2019 showed that addition of *SOS3* to commercial standard fertilisers increases the crop yield by 17.8% and the commercial cane sugar (CCS) yield by 12% compared to control without *SOS3*.

Application

The majority of the field trials conducted is for broadacre grain (corn, sorghum, etc.) and sugarcane. To date, the most effective and commercially viable mechanism is seed treatment which requires the lowest rate of bacterial product and generates the highest margin. However, for plants where seed treatment is not possible (for ex. sugarcane) or desirable (horticulture, trees) bacterial treatment on a mineral carrier was developed. With the recent method of protective barrier (MCC) tested it is confirmed that non-forming spores *SOS3* in dry form can be successfully blended with commercial chemical fertilisers (ongoing experiment) demonstrating abilities to survive in the presence of a high concentration of salts. MCC also effectively protects bacteria from UV radiation.

Tomato trials conducted in 2019 and recent commercial sugarcane trials proved that mineral carrier treated with bacteria can effectively deliver *SOS3* to the plants comparing to a positive control (standard practice).

In 2016 *SOS3* was initially tested in hydroponics showing strong yield increase and bio protection capabilities. Due to the mutualistic nature, this bacterium is not washed out from hydroponic systems being attached to the roots. Hydroponic experiments were suspended in favour of broadacre ones not only because of the bigger revenue expected but also because of the open nature of hydroponic systems where all plants (tomato, cucumbers, leafy greens, etc.) are growing together and bacterial treatment needs to be thoroughly tested on **all** plants before introducing into the hydroponic systems to avoid any potential damage.