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Nitragin
El número uno en inoculantes y promotores de crecimiento.

# Enhanced fertility of eroded arid soil using recycled waste debris of wastewater treatment containing microalgae and *Azospirillum brasilense* as inoculant

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A fundamental end goal for developing any green technology for large environmental application is minimal or no secondary production of pollution. Urban wastewater treatment is currently done with a variety of physical and chemical treatments and to a lesser extent by biological technologies (bacteria and microalgae) all leading to massive quantities of secondary pollutants that mostly end in landfills. Some sludge debris from domestic wastewater are placed on fields as fertilization. Runoff and leaching of nutrient rich amendments are consequently responsible for large scale eutrophication of water bodies on global scale.

An efficient biological wastewater technology using immobilized microalgae and plant growth-promoting bacteria (PGPB) has been developed and is currently undergoing scaling up. Similar to other biological technologies, it yields large amounts of living biomass at the end of the wastewater treatment cycles. In our earlier studies, we showed that the debris is composed of a large quantity of microalgae harboring most of the nitrogen and phosphorus absorbed from wastewater and converted to proteins and other cell components, plus fixed carbon from photosynthesis. Therefore, the hypothesis of this study is that, as a whole, microalgae are serving as supplemental organic matter, and in combination with the live PGPB in the waste debris, can be used to amend soils in highly eroded arid regions. Improved soil provides a suitable substrate for desert vegetation and crop plants where they could not grow. Furthermore, this type of debris, serving as a PGPB inoculant as its secondary role, enhances plant

growth. As a result, the debris from this wastewater technology becomes a *resource* for improving soils and diverts waste product from landfills.

Waste debris of alginate beads containing the microalgae *Chlorella sorokiniana* and the PGPB *Azospirillum brasilense* Cd that were used for tertiary wastewater treatment were then used to improve fertility of eroded arid soil and promote plant growth. *A. brasilense* could survive well in these already used dried beads for at least one year. Three consecutive applications of these biologically dry debris increased organic matter, organic carbon, and microbial carbon in the soil. Growth of sorghum plants in amended soil was greater than plants grown in eroded soil or soil amended with beads containing other combinations of alginate, microalgae, or bacteria. The surfaces of plant roots growing in the amended soil were heavily colonized by the PGPB, with no endophytic colonization; the root tips were the preferred sites of colonization. This study demonstrates that biological residues from an innovative biological wastewater treatment program can serve a secondary role as a resource for improving arid soil quality and enhancing plant growth.