

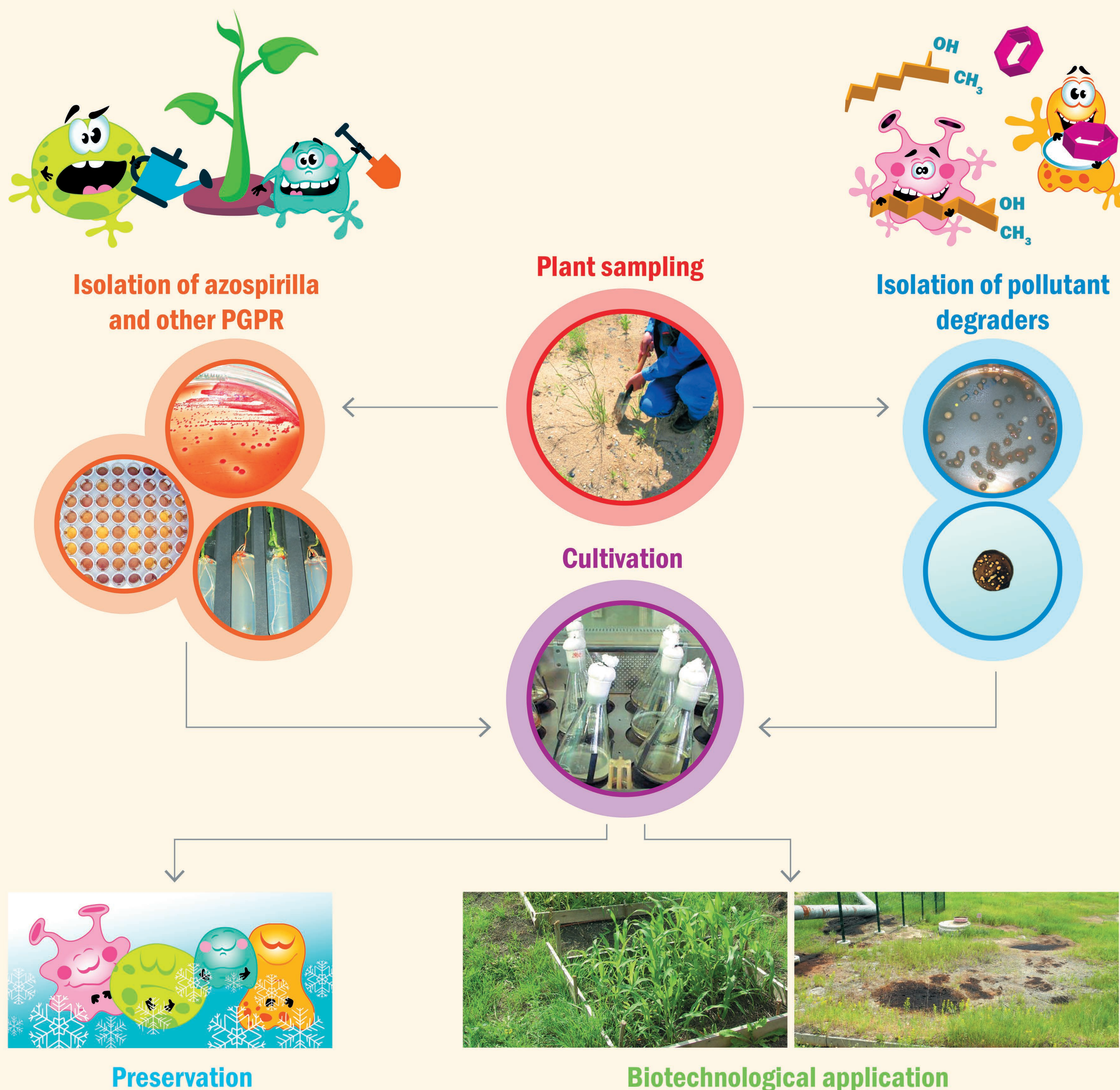


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# Biotechnological potential of the IBPPM RAS Collection of Rhizosphere Microorganisms

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The Collection of Rhizosphere Microorganisms of the IBPPM RAS is a specialized scientific depository focused on selecting and maintaining nonpathogenic bacteria, isolated mainly from the root zone of plants. The collection houses about 500 cultures of bacteria of different taxons, isolated from different ecological niches, but mostly from plant organs and the surrounding zones (roots, seeds, nodules, rhizosphere, rhizoplane, and phyllosphere). Most of the strains are adapted to life in association with plants growing in a variety of environments, including man-made pollution. In this regard, the collection is a promising source of natural microbial resources, which can be used to make effective biological products for agricultural and environmental purposes. The strains maintained in the collection have a number of properties useful for environmental and agricultural biotechnology and are conditionally assigned to the groups of “biofertilizers” and “bioremediators”.

The **Biofertilizers** group includes about 200 PGPR (plant-growth-promoting rhizobacteria) strains that stimulate plant growth through improving nutrition (e.g., by nitrogen fixation, solubilization of insoluble phosphates, or production of phytohormones). The main feature of the collection is the largest assortment of bacteria of the *Azospirillum* genus — typical PGPR. Testing of these microorganisms as inoculants for agri-

cultural crops has shown that they increase the productivity of their plant partners and, therefore, can serve as a basis for commercial agricultural bioagents [e.g., “Organit N” (<http://bi-onovatic.ru>)]. PGPR strains also can be used in phytoremediation, because their activity promotes plant root growth under contaminated conditions. On the one hand, this increases the numbers of useful roots-associated bacteria owing to the appearance of new niches, and on the other hand, this increases the release of plant catabolic enzymes as part of root exudates to degrade persistent organic pollutants (e.g., hydrocarbons or pesticides) or, conversely, improves the extraction of inorganic pollutants (heavy metals and metalloids) from the root zone.

Members of the **Bioremediators** group have the characteristic ability to degrade persistent organic pollutants and/or resist to inorganic ones. The global pollution of the environment by petroleum hydrocarbons, pesticides, heavy metals and metalloids, as well as the possibility of improving the ecological situation through such low-cost and eco-friendly technologies as bio- and phytoremediation, based on the use of plant-microbial associations ensure the interest in these microorganisms. The collection’s bioremediators group includes strains degrading crude oil and petroleum products, polycyclic aromatic hydrocarbons (PAH), and herbicides, as well as

strains resistant to arsenic and heavy metals. Our studies on the optimization of phytoremediation led us to develop protocols for the use of several collection strains in this technology. Plant-microbial associations have been developed to restore soils exposed to various technogenic pollutants. The effectiveness of the selected plant-microbial associations in the decontamination of soil from oil hydrocarbons, glyphosate, heavy metals, and arsenic has been experimentally proved. These developments are protected by Russian patents (Patent RU 2403102, Patent RU 2406758).

A number of strains from the IBPPM Collection of Rhizosphere Microorganisms that can be used as biofertilizers and bioremediators have been included in the PERN (Pan-European Rhizosphere Resource Network, <http://www.PERN-BRIO.eu>) database, organized as a virtual collection containing beneficial microorganisms isolated from the rhizosphere and constituting a virtual, common, and wide-ranging pool of microbial rhizosphere diversity that is exploitable in research and industry. The description of each strain in the network is accompanied by data on taxonomy, methods of isolation and identification, storage and cultivation conditions, properties of microorganisms with an emphasis on biotechnological significance, and bibliographic sources.