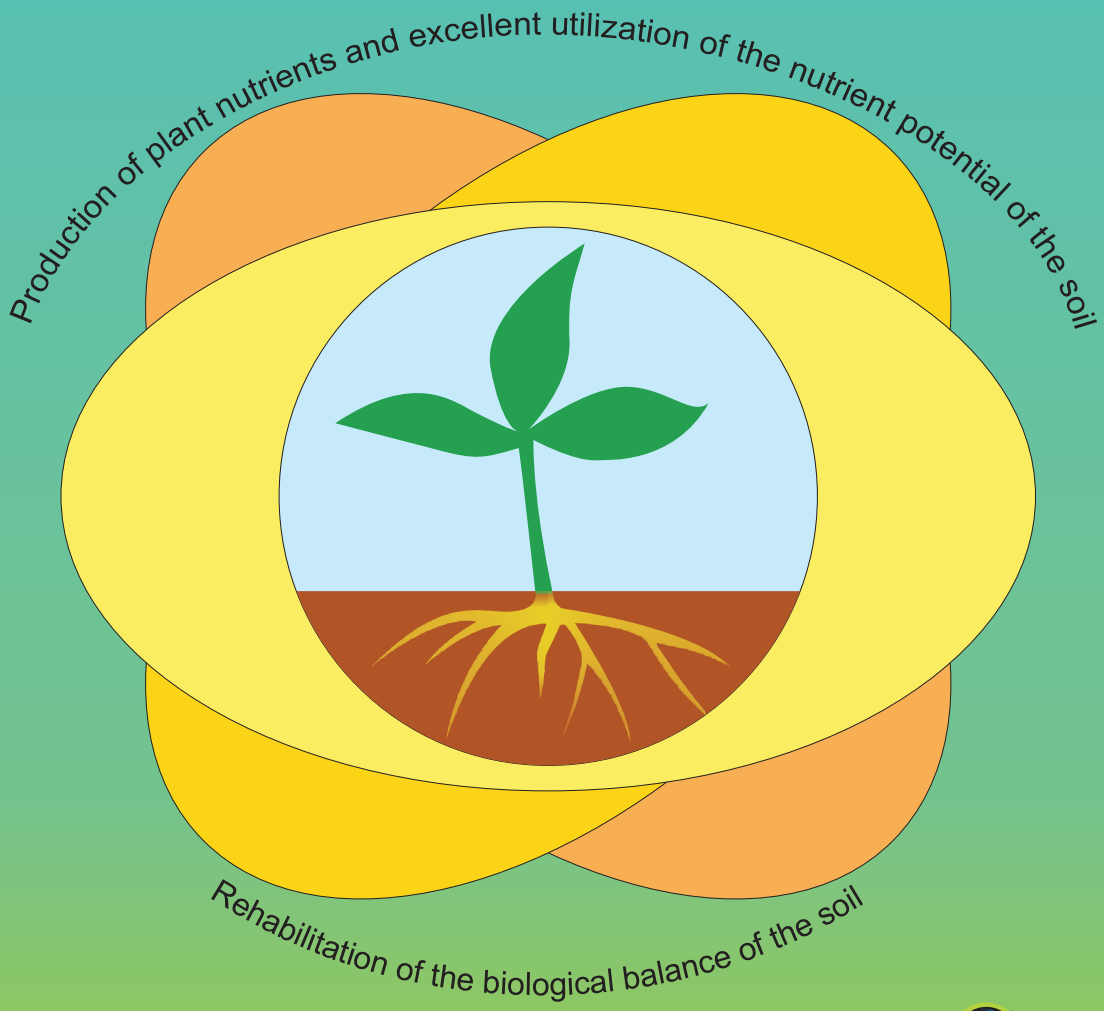
SOIL CONDITIONER WITH BENEFICIAL BACTERIA

PhosBactin

AzoRiz

AzoSpir



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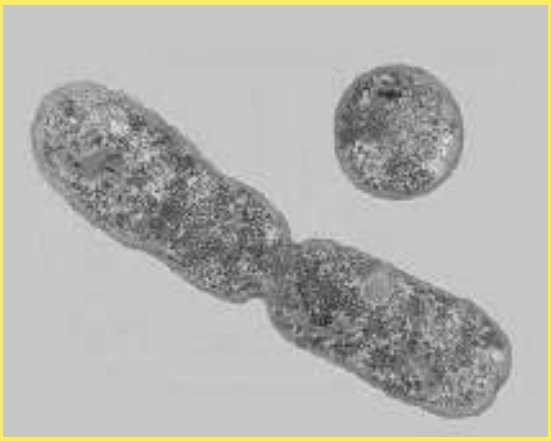


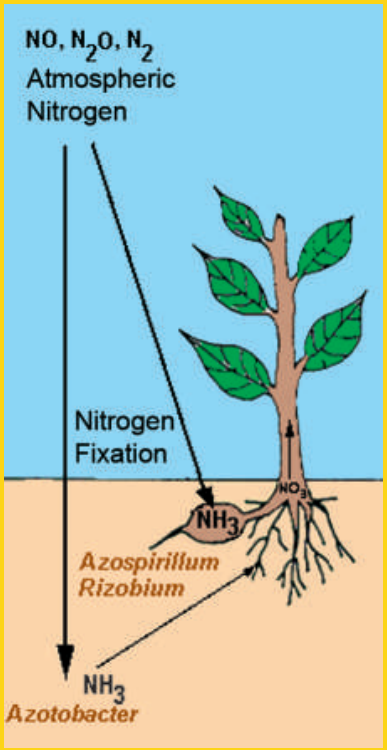
The secret of creation at the service of humanity

It is well known that the two most important elements for the plant growth are Nitrogen and Phosphorus. Without these two main elements, the soil remains infertile and idle. The application of fertilizers for the supplement of the soil with the required units of nitrogen and phosphorus is surely a solution to the increasing needs for these elements caused by the systematic and many times intensive cropping. But is it also an economical solution? Is there a way to reduce the amount of fertilizers and achieve the same result in a more economic manner? The answer is given by nature and the mechanisms through which life was created on our planet.

Bacteria were the first living organisms on earth. Some species of bacteria started using the atmospheric nitrogen and converting it into mineral nitrogen compounds in the soil. Nowadays, the exact same mechanism is also capable to offer significant amounts of nitrogen contributing to the reduction of the required for the crops' growth amounts of nitrogen fertilizers. Furthermore, some other species of bacteria are capable of converting the insoluble and unwieldy compounds of phosphorus to active and easily assimilable phosphorus forms. In this way the Phosphate solubilizing bacteria can significantly reduce the amounts of the applied phosphate fertilizers.

What are Nitrogen-fixing bacteria?

Nitrogen-fixing bacteria are usually soil bacteria which are either free-living or symbiotic with plants and play a very important role in the nitrogen cycle. The free-living nitrogen-fixing bacteria bind the molecular nitrogen of the atmosphere and convert it to ammoniac ions in the soil. After that, the ammoniac ions undergo the nitrification process (ammoniac ions are converted to nitrate ions) and finally the arising nitrate ions are absorbed by the plants. As for the symbiotic nitrogen-fixing bacteria, they also bind the atmospheric nitrogen and convert it to ammoniac ions, but in this case the bacteria provide the nitrogenous compounds to the plants. Thus the plants can be directly supplied with nitrogen in order to synthesize their proteins, vitamins and other nitrogenous compounds.



Which are the main Nitrogen-fixing bacteria?

The main and most known nitrogen-fixing bacteria are these of the genus of *Azospirillum*, *Rhizobium* and *Azotobacter*.

Azospirillum sp **:** The bacteria of the genus *Azospirillum* establish a symbiotic association with the roots of the crops (mostly cereals but also others) and convert the atmospheric nitrogen to an easily assimilable form that can be directly used by the plants. When *Azospirillum sps* are applied on the root or are sprayed on the leaves of the plants, they enter the cells of the root or the leaves and become endophytes releasing the nitrogenous compounds directly to the plant tissues. It is estimated that *Azospirillum sps* can offer from 20 to 460 kg of nitrogen/ha per year, reducing remarkably the cost of the nitrogen fertilization.

Rhizobium sp **:** *Rhizobium sps* are nitrogen-fixing bacteria that live in symbiosis with the leguminous plants. Specifically they colonize plant cells within root nodules, where the atmospheric nitrogen is converted to a readily assimilated by the plants form. It is estimated that the *Rhizobium sps* can offer from 50 to 60 kg of nitrogen/ha per year.

Azotobacter sp **:** *Azotobacter sps* are free-living soil bacteria which bind the molecular nitrogen from the atmosphere and convert it to ammoniac ions. In this way they increase the nitrogen content in the soil, covering a large part of the plants' needs for nitrogen. Especially plants such as wheats, vegetables, fruit trees, forest trees, vineyard, sugarcane, cotton, rice and bananas can be supplied with large amounts of the necessary for their growth nitrogen by the free-living nitrogen fixing bacteria. It is estima-ted that the Azotobacter sps nitrogen-fixing bacteria can offer from 20 to 40 kg of nitrogen/ha per year, reducing remarkably the cost of the nitrogen fertilization.

What do Nitrogen-fixing bacteria offer to plants?

- They bind the atmospheric nitrogen, convert it to an assimilable for plants form and provide it to plants increasing in this way the crop yields.
- They increase seed germination. Studies have shown that seeds which have been treated with nitrogen-fixing bacteria have shown an increase in their germination rate by 20-30%.
- They contribute to the formation of a better soil structure.
- They have a positive effect on the growth of the root system.
- Symbiotic nitrogen-fixing bacteria (*Azospirillum sp* and *Rhizobium sp*) occupy positions on the root inhibiting the plant pathogens' establishment on the root.
- They secrete substances (through the metabolism), which either have an anti-fungal action or reinforce the defense of the plant against soil pathogens.

What are the Phosphate solubilizing bacteria?

There are strains of bacteria such as *Bacillus megaterium vP* and *Pseudomonas putida* which are free-living soil bacteria, decomposers and also capable of converting the phosphorus from insoluble compounds (one of the most immobile nutrients) to a form that can be easily assimilated by the plants.

When the spores of *Bacillus megaterium vP* are applied in the soil, they germinate. The arising bacteria with the *Pseudomonas putida* bacteria start to proliferate using the organic compounds of the soil (dead organic matter) and the secreted substances of the roots. In the same time they solubilize the immobile phosphorus of the soil by converting it into a directly assimilable form.

What do Phosphate solubilizing bacteria offer to plants?

- They increase their population and hydrolyze phosphorus from insoluble and immobile compounds of the soil.
- They improve the soil physicochemical properties.
- They contribute to the growth of a healthy root system.
- They secrete metabolites which fortify the defense of the plants against soil pathogens.

AzoRiz

AzoRiz is a microbial inoculant containing beneficial nitrogen-fixing bacteria. In specific **AzoRiz** contains:

1×10^{12} Rhizobium sps.
1×10^{12} Azotobacter sps.

Furthermore, **AzoRiz** has as a carrier an ideal combination of organic plant nutrients which include humic acids, amino acids, sugars and natural plant growth regulators. The carrier of **AzoRiz** promotes not only the root and plant growth but also the establishment and the proliferation of the nitrogen-fixing bacteria.

RECOMMENDED CROPS

Legumes (Beans, Peas, Lentils, Chickpeas others), Soya, Peanut and other oil seeds, Clover, Alfalfa, Carrot, Beetroot, Sweet potato.

PROPERTIES

- ✓Increases gradually the soil's nitrogen content that is readily available to plants.
- ✓ Restricts the use of chemical nitrogen fertilizers by reducing the amount of the chemical nitrogen which is required for covering the plants needs.
- ✓ Contributes to the reduction of the environmental pollution caused by the excessive use of chemical nitrogen fertilizers.
- ✓ Obtains an equable growth of the crops since nitrogen-fixing bacteria offer nitrogen throughout the growing season.
- ✓ Contributes significantly in maximizing crop production.
- ✓ Contributes to the better soil aeration.
- ✓ Enhances the root system branching and the root elongation and penetration, which in turn will serve the uptake of soil water and minerals by the plants.
- ✓ Promotes the plant growth and fortifies the plant resistance due to the phytohormones and other substances that are secreted by the nitrogen-fixing bacteria.
- ✓ Improves the physicochemical properties of the soil.
- ✓ Adds organic matter in the soil which stimulates the beneficial soil microbial activity.
- ✓ Increases the cation exchange capacity of the root.
- ✓ Increases highly the seed germination.
- ✓ Enriches the soil with beneficial microorganisms that contribute to the enhancement of the root growth and plant health.
- ✓ Increases crop yield.
- ✓ Contributes to the development of a cost-effective crop resulting in the increase of the farmers' profit.

AzoSpir

AzoSpir is a microbial inoculant containing beneficial nitrogen-fixing bacteria. In specific **AzoSpir** contains:

1×10^{12} Azospirillum sps.
1×10^{12} Azotobacter sps.

Furthermore, **AzoSpir** has as a substrate an ideal combination of organic plant nutrients which include humic acids, amino acids, sugars and natural plant growth regulators. The substrate of **AzoSpir** promotes not only the root and plant growth but also the establishment and the proliferation of the nitrogen-fixing bacteria.

RECOMMENDED CROPS

Cereals, Rice, Vegetables, Horticulture, Trees, Vineyard, Ornamental plants and bushes.

PROPERTIES

- ✓Increases gradually the soil's nitrogen content that is readily available to plants.
- ✓ Restricts the use of chemical nitrogen fertilizers by reducing the amount of the chemical nitrogen which is required for covering the plants needs.
- ✓ Contributes to the reduction of the environmental pollution caused by the excessive use of chemical nitrogen fertilizers.
- ✓ Obtains an equable growth of the crops since nitrogen-fixing bacteria offer nitrogen throughout the growing season.
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- ✓ Promotes the plant growth and fortifies the plant resistance due to the phytohormones and other substances that are secreted by the nitrogen-fixing bacteria.
- ✓ Improves the physicochemical properties of the soil.
- ✓ Adds organic matter in the soil which stimulates the beneficial soil microbial activity.
- ✓ Increases the cation exchange capacity of the root.
- ✓ Increases highly the seed germination.
- ✓ Enriches the soil with beneficial microorganisms that contribute to the enhancement of the root growth and plant health.
- ✓ Increases crop yield.
- ✓ Contributes to the development of a cost-effective crop resulting in the increase of the farmers' profit.

PhosBactin

PhosBactin is a microbial inoculant containing beneficial Phosphate solubilizing bacteria that are capable of dissolving and mobilizing the insoluble soil phosphorus. In specific **PhosBactin** contains:

1×10^{12} *Bacillus megaterium vP*

Furthermore, **PhosBactin** has as a substrate an ideal combination of organic plant nutrients which include humic acids, amino acids, sugars and natural plant growth regulators. The substrate of **PhosBactin** promotes not only the root and plant growth but also the establishment and the proliferation of the nitrogen-fixing bacteria.

RECOMMENDED CROPS

Cereals, Rice, Fodders (clover, lucerne, alfalfa etc.), Legumes (beans, lentils, peas, chickpeas etc.), Vegetables, Horticulture, Trees, Vineyard, Ornamental plants and bushes.

PROPERTIES

- ✓Solubilizes the insoluble and immobile soil mineral phosphorus.
- ✓Solubilizes the immobile phosphorus of the phosphate fertilizers and coverts it to available to the plants forms (large portion of soluble inorganic phosphate which is applied to the soil as chemical fertilizer is immobilized rapidly and becomes unavailable to the plants).
- ✓Eliminates the use of phosphate fertilizers since it reduces the required amount of phosphate fertilizers for covering the plants needs for phosphorus.
- ✓Contributes to the development of very cost-effective crops since it reduces the applications of phosphate fertilizers.
- ✓Contributes to the reduction of environmental pollution caused by excessive use of chemical phosphate fertilizers.
- ✓Improves the nutrient uptake by the plants.
- ✓Contributes to the better aeration of the soil and the deeper penetration of the root system while at the same time promotes the growth of the root system through the metabolites of the beneficial bacteria.
- ✓Reduces soil erosion and improves soil structure.
- ✓Adds organic matter in the soil which ensures the establishment of the phosphate solubilizing bacteria in the soil and also stimulates the beneficial microbial activity.
- ✓Increases the cation exchange capacity of the root.
- ✓Promotes an early and efficient seed germination.
- ✓Promotes the plant growth and fortifies the plant resistance due to the substances that are secreted by the phosphate solubilizing bacteria.
- ✓Increases crop yield and contributes to the development of healthy plants with great resistance to environmental and biotic stress factors.
- ✓Increases the farmers' profit.

APPLICATIONS - APPLICATION RATES

Soil conditioners with beneficial bacteria AzoSpir, AzoRiz and PhosBactin can be applied to crops with one of the following ways:

Dipping of Seeds - Tubers: Dissolve the appropriate amount of the product (according to the application rate table) in a sufficient amount of water capable of soaking all of the seeds. Dip the seeds in the solution and shake well until the seeds are soaked thoroughly. Let the seeds dry for ½ hour and then sow them in the soil.

Dipping of Seedlings: Dilute the appropriate amount of the product in the water (according to the application rate table) and dip the plantlets in the solution for ½ hour before transplanting.

Dipping of Cuttings: Dilute a suitable amount of the product in the water (according to the application rate table) and dip the cuttings in the solution for ½ hour before planting.

Mixing with manure: Spray or water the manure with an appropriate amount of the product (according to the application rate table) and mix well. Cover the manure and leave it in moisture about 40-50% for a whole night. The next day spread the manure before the last plowing or the first watering.

Soil Application: Fertigation through the irrigation/fertilization system or by drenching around the root at the recommended application rate (application rate table). It is recommended the products to be combined with a liquid soil conditioner.

Foliar Application: Apply according to the recommended dilution rate and aim at the full coverage of the cultivated area. Then it is recommended to water the crop by mist spraying or gun sprinkler in order the product to descend in the soil.

	AzoSpir	AzoRiz	PhosBactin
Dipping of Seeds - Tubers	5-10 ml per kg of seed	40-80 ml per kg of seed	5-10 ml per kg of seed
Dipping of Seedlings	50-100 ml per 10-20 l of water	50-100 ml per 5-10 l of water	50-100 ml per 10-20 l of water
Dipping of Cuttings	125-250 ml per 60-75 l of water for 1 ha		100-250 ml per 60-70 l of water for 1 ha
Mixing with manure	1-2 l per 200-300 kg of manure for 1 ha	1-1.5 l per 1,000-1,500 kg of manure for 1 ha	1-2 l per 200-300 kg of manure for 1 ha
Soil Application	1.25-7.5 l per ha	2.5-7.5 l per ha	2.5-5 l per ha
Foliar Application	1.25 l per 1,000 l of water per ha	1.25 l per 500 l of water per ha	1.25-2.5 l per 1,000 l of water per ha

APPLICATION PER CROP

Cereals, Rice: Dipping of seeds - Mixing with manure before sowing - Foliar application before sowing or at least at the 10-20 cm stage.

Vegetables, Horticulture: Dipping of seeds before sowing - Dipping of seedlings before transplanting - Soil application right after transplanting - Mixing with manure before planting - Foliar application at the early growth stages (4-6 weeks after planting and repeat 2-3 weeks later if necessary).

Trees, Vineyard: Soil application - Mixing with manure at the beginning of the growing season. Manure must always be incorporated in the soil. Dipping of cuttings is recommended for new plantings.

Ornamental plants and bushes: Soil application or Foliar application at the early growth stages or at the beginning of the growing season.

Legumes (Beans, Peas, Lentils, Chickpeas etc.) : Dipping of seeds - Dipping of seedlings before transplanting - Mixing with manure before sowing - Soil application right after planting - Foliar application right after the emergence in the soil.

Soya, Peanut and other oil seeds : Dipping of seeds - Dipping of seedlings before transplanting - Mixing with manure before sowing -Soil application right after planting - Foliar application right after the emergence in the soil.

Clover, Alfalfa : Dipping of seeds - Mixing with manure before sowing - Soil application right after planting - Foliar application right after the emergence in the soil.

Carrot, Beetroot, Sweet potato : Dipping of seeds - Mixing with manure before sowing - Soil application right after planting.