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Azotobacter as biofertilizer: A Review

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Abstract

Biofertilizers are natural materials include living microorganisms that improve the soil nutrient content and encourage plant development. Mycorrhizal fungi, phosphate-solubilizing bacteria, and nitrogen-fixing bacteria such as Azotobacter and Rhizobium are common forms of biofertilizers. Soil contains free-living nitrogen-fixing bacteria belonging to the genus Azotobacter. Because they transform atmospheric nitrogen (N2) into ammonia, which plants can use as a fertilizer, these bacteria essential to the nitrogen cycle. Because of its capacity to flourish in aerobic environments, Azotobacter is frequently found in agricultural soils, where it enhances soil fertility. This abstract aims to comparatively study the efficiency of different species of Azotobacter as a biofertilizer.

Keywords: Azotobacter, Biofertilizers, Soil fertility, Nitrogen fixation

Introduction

Biofertilizers are products that contain cells from various helpful microorganisms. Bacteria that promote plant (PGPB) of all microbes. *A*zotobacter species are the most promising. It is a free-living, aerobic, N2 fixing bacterium that often inhabits sediments, water, and soil. The species of Azotobacter used as the biofertilizer involves *Azotobacter chroococcum*, *Azotobacter salinestris*, *Azotobacter nigricans*, *Azotobacter vinelandii* (Khosro Mohammadi *et al.*, 2012). New strategies to lessen the use of harmful agrochemicals are needed for sustainable agriculture production. Specifically the use of synthetic nitrogen fertilizers poses a significant environmental risk because of the pollution they cause during manufacture and use (Alka Sagar *et al.*, 2022). *Azotobacter* species enhance the activity of

rhizosphere microorganisms, generates inhibitors of phytopathogens, and suyntheizes physiologically active compounds, all of which contribute positively to crop growth and yield. Ultimately increasing biological nitrogen fixing (Felipe Romero-Perdomo *et al.*, 2017).

Azotobacter as biofertilizer

In order to provide soil with nitrogen, Gerlach and Voel developed the use of *Azotobacter* as biofertilizer. In addition to fixing atmospheric N_2, this bacterium aids in the production of PGRs like auxins, cytokinin, gibberellins, amino acid, and vitamins, as well as other growth-promoting activities like phosphate solubilisation (Jenita Nongthombam *et al.*, 2021).

Azotobacter in soil fertility

Numerous soil physic-chemicals (such as organic matter, soil moisture and soil temperature) and microbiological characteristics are positively correlated with the abundance of *Azotobacter* spp, in soil, which also improves seed germination and has a positive effect on Crop Growth Rate (Jenita Nongthombam *et al.*, 2021).

Azotobacter in Nitrogen Fixation

The most significant biological and microbiological activity occurring on the earth's surface immediately following photosynthesis is nitrogen fixation. Biological nitrogen fixation plays a critical function in preserving soil fertility. Because grows quickly and has high level of nitrogen fixation, it can be utilized to study nitrogen fixing and plant inoculationn (Jenita Nongthombam *et al.*, 2021).

Azotobacter sps. as a biofertilizer

In research by Alka Sagar *et al.*, used *Azotobacter nigricans* with the carrier material of Nitrogen Phosphorous, Potassium on the Maize plants which exhibit a notable improvement in root and shoot elongation and a notable increase in seed germination when compared to the untreated control (Alka Sagar *et al.*, 2022).

In a study by Alami N H *et al.*, used *Azotobacter A10* with molasses on Mustard plant for the significant increase in the height of the plant and its productivity (Alami N H *et al.*, 2018).

In research by Esteban Julian Rubio *et al* focused on the production of biofertilizers using *Azotobacter salinestris* on the Wheat plants that enhanced the quantity of root hairs and seminal roots in wheat seedlings, also classified the strains according to the formation of siderophores, nitrogenise activity, phytohormone biosynthesis, and phosphate solubilisation (Rubio *et al.*, 2013).

Table 1: *Azotobacter sps.* as a biofertilizer

Species	Plant	Carrier	State	Application	Efficiency	Reference
Azotobacter nigricans	Maize	Nitrogen, Phosphorous, Potassium	Liquid	Seeds	Produced seedlings greatly	Alka Sagar *et al.*, 2022
Azotobacter A10	Mustard	Molasses	Solid	Soaked seeds	Increased growth & productivity	Alami N H *et al.*, 2018
Azotobacter chroococcum	Pearl millet	Charcoal	Solid	Roots	Compared to charcoal 2% glycerol & 2% Polyvinylpyrrolidone was best carrier	Acharya Payal Kaushikkumar, 2007
Azotobacter chroococcum	Pearl millet	2% glycerol & 2% Polyvinylpyrrolidone	Liquid	Roots		
Azotobacter chroococcum	Maize	Gel containing 75% nitrogen	Liquid	Seeds	Increase plant height & number of grains	Kumaresan G *et al.*, 2019
Azotobacter chroococcum	Tomato	Liquid containing 75% nitrogen	Liquid	Seeds	Stimulate higher amount of PGPR	Kumaresan G *et al.*, 2019

Acharya Payal Kaushikkumar carried out research on three different formulations like liquid, carrier and granular with *Azotobacter chroooococcum* (ABA-1) to treat Pearl millet crop which concluded that accordingly, liquid formulation with 2% glycerol and 2% PVP was better than the carrier which increases the density of the cells significantly. (Acharya Payal Kaushikkumar 2007).

Conclusion

Azotobacter is a type of free-living bacteria that can convert atmospheric nitrogen into a form that plants can easily use, making it a valuable biofertilizer. Its capacity to enhance soil fertility by supplying accessible nitrogen to plants contributes to increases crop yields and lessens the dependence on chemical fertilizers, positioning it as an important resource for sustainable agriculture with a minimal ecological footprint. The benefits of *Azotobacter* inoculation on a range of crops are demonstrated through case studies, which demonstrate notable improvements in soil health and productivity. The potential of *Azotobacter* biofertilizers to support environmentally friendly farming methods, improve food security, and support sustainable agricultural practices is emphasized in the conclusion.

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