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Nitrogen-Fixing Crops and Microbes: Improving Soil Fertility for Natural Farming

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Abstract
By understanding the significance of the crops and their interactions with beneficial microbes, farmers can optimize soil fertility and improve overall agricultural productivity. Nitrogen fixation is the process by which certain crops, particularly legumes, form a partnership with nitrogen-fixing bacteria, enabling them to convert atmospheric nitrogen into a usable form. The benefits of incorporating nitrogen-fixing crops into crop rotation systems and as cover crops are also explored. The paper discusses various crops known for their nitrogen-fixing abilities, such as legumes (e.g., soybeans, alfalfa, clover), lupins, vetches, faba beans, and cowpeas. These crops enrich the soil with nitrogen, reducing the need for synthetic fertilizers and promoting sustainable agricultural practices. This paper explores the role of nitrogen-fixing crops and their symbiotic relationship with microbes in enhancing soil fertility.

Key words: Nitrogen-fixing crops, Soil fertility, Symbiotic relationship, Microbes, Legumes

Introduction
Natural farmers rely significantly on biological nitrogen fixers and pulses for maintaining soil fertility and spreading the word about sustainable agricultural practises. Leguminous plants have nitrogen-fixing bacteria colonising their root nodules in a symbiotic relationship. As a source of nitrogen, they are beneficial to both plants and soil. Biological nitrogen fixation refers to the process by which microorganisms like bacteria and archaea convert atmospheric nitrogen into a form that plants can use. By incorporating biological nitrogen fixers into already-established farming practises, farmers can drastically reduce their reliance on synthetic nitrogen fertilisers, the production of which consumes a lot of energy and has potential environmental consequences. Future crop success is aided by the added nitrogen, and less artificial nitrogen fertiliser is required. By replenishing nitrogen levels, pulses cultivated organically boost soil quality. Pulses, a class of leguminous crops, includes foods including lentils, chickpeas, beans, and peas. They do this by forming symbiotic relationships with microorganisms that fix nitrogen in the soil. Using biological nitrogen fixers and pulses in conjunction with one another in organic farming has several positive outcomes.

The ability to convert atmospheric nitrogen into a form usable by plants is a boon for pulses and other crops. This contributes to a more resilient nutrient cycle by decreasing nitrogen losses and maintaining soil fertility. Biological nitrogen fixers play an important part in agricultural settings as part of the nutrient cycle. Long-term agricultural viability and productivity depend on its effects on soil structure, water retention, and beneficial microbial activity. Soil health and fertility are improved by nitrogen fixation because of the process's ability to raise the level of organic nitrogen there. Reducing the amount of nitrogen compounds in the environment helps reduce the severity of problems including water

pollution, greenhouse gas emissions, and ecological imbalances. Natural farmers are able to reduce their environmental impact by using less synthetic nitrogen fertilisers because to biological nitrogen fixation and pulses. Planting a greater diversity of crops strengthens and stabilises the entire ecosystem. Pulses can be used in crop rotation in natural farming systems to reduce weed pressure, improve soil quality, and interrupt insect and disease life cycles. Growing and selling pulses, which are used for both human consumption and animal feed, might provide new opportunities for financial gain. In order to save money on synthetic nitrogen fertilisers, many farmers are turning to biological nitrogen fixers and pulses. Biological nitrogen fixers and pulses are crucial to the long-term viability of organic farms. They improve soil fertility, increase nutrient cycling, reduce environmental impact, and support sustainable farming practises.

Nitrogen fixation is the conversion of atmospheric nitrogen (N_2) into a usable form, such as ammonium (NH_4^+), by certain microorganisms. There are several crops that have the ability to increase nitrogen content in soils through a process called nitrogen fixation. These crops form a symbiotic relationship with nitrogen-fixing bacteria, which live in nodules on their roots. When these crops are grown, they enrich the soil with nitrogen, benefiting themselves and subsequent crops. They host symbiotic bacteria called rhizobia, which convert atmospheric nitrogen into a form that can be used by the plant. Leguminous crops like soybeans, alfalfa, clover, and peanuts are well-known for their nitrogen-fixing abilities.

Lupins: They are commonly grown as forage crops and are also used in some regions for human consumption. Lupins can contribute significant amounts of nitrogen to the soil. Lupins are another type of legume known for their nitrogen-fixing properties.

Vetches: Common varieties include hairy vetch and common vetch. These plants are typically grown alongside cash crops or during fallow periods to improve soil fertility. Vetches are a group of nitrogen-fixing plants that are often used as cover crops or green manures.

Faba beans: Faba beans can enhance soil nitrogen levels when incorporated into crop rotation systems. Faba beans, also known as broad beans, are leguminous crops that possess nitrogen-fixing capabilities. They are cultivated for both human consumption and animal feed.

Cowpeas: Cowpeas are well-suited for intercropping and can improve soil fertility in agricultural systems. Cowpeas, also known as black-eyed peas, are legumes that have the ability to fix atmospheric nitrogen. They are commonly grown in warm regions as food crops and for forage.

The increased nitrogen content in the soil benefits subsequent crops, leading to improved overall productivity. By cultivating these nitrogen-fixing crops, farmers can reduce their reliance on synthetic fertilizers and promote sustainable agricultural practices.

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