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CHEMICAL AND BIOLOGICAL ASSESSMENT OF NITROGEN CYCLE PROCESSES IN AGRICULTURAL SOILS

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Abstract

The nitrogen cycle is one of the most important biogeochemical processes supporting soil fertility and plant productivity. Agricultural soils are strongly influenced by nitrogen fertilizers, microbial activity, and environmental conditions. This study analyzes chemical and biological aspects of nitrogen transformation in agricultural soils. The findings indicate that nitrification, denitrification, ammonification, and nitrogen fixation regulate nutrient availability and affect environmental sustainability.

Keywords: nitrogen cycle, agricultural soils, nitrification, denitrification, soil biology, nitrogen fertilizers

Introduction

Nitrogen is an essential nutrient required for amino acids, proteins, nucleic acids, and chlorophyll synthesis. In soils, nitrogen exists in organic and inorganic forms and is transformed by microbial processes. Agricultural intensification has increased nitrogen fertilizer use, improving crop yield but also causing nitrate leaching, greenhouse gas emissions, and soil imbalance. Understanding nitrogen cycle processes is essential for sustainable farming.

Materials and Methods

The article reviewed soil chemistry and microbiology studies related to nitrogen cycling. Processes of ammonification, nitrification, denitrification, and biological nitrogen fixation were analyzed. Indicators such as soil nitrate, ammonium, microbial biomass, and enzyme activity were considered.

Results

Microbial activity was central to nitrogen transformation. Nitrifying bacteria converted ammonium into nitrate, while denitrifying microorganisms reduced nitrate under anaerobic conditions. Excess nitrogen fertilizers increased nitrate accumulation and environmental losses. Leguminous plants and nitrogen-fixing bacteria contributed to natural nitrogen enrichment.

Discussion

Nitrogen cycling connects chemical and biological soil processes. Balanced nitrogen management improves crop productivity and reduces environmental risks. Overuse of fertilizers disrupts microbial processes and contributes to water pollution. Sustainable strategies include precision fertilization, crop rotation, organic amendments, and use of nitrogen-fixing plants.

Conclusion

Chemical and biological nitrogen transformations are essential for agricultural soil fertility. Effective nitrogen management requires understanding microbial processes and fertilizer dynamics. Sustainable approaches can improve productivity while minimizing environmental impact.

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