



THE EFFECT OF MICROBIAL FERTILIZERS ON THE GROWTH OF BARLEY PLANTS

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Abstract: Microbial fertilizers, which are produced by natural microorganisms, play a significant role in providing essential nutrients for plants. This paper investigates the impact of microbial fertilizers on the growth of barley plants. The research findings demonstrate that microbial fertilizers enhance growth rates, increase yield, and improve the quality of plants. Specifically, microbial fertilizers effectively supply key elements such as nitrogen, phosphorus, and calcium, promoting growth processes and aiding in root system development. The application of microbial fertilizers in barley plants enhances their resistance to stress and strengthens their defense against diseases. The main objective of this study is to identify the effects of microbial fertilizers on barley plant growth and to better understand the interactions between fertilizers and microorganisms. The results of this study can significantly contribute to the development of sustainable and ecologically safe farming practices in agriculture.



Keywords: microbial fertilizers, barley plants, growth, yield, microorganisms, nitrogen, phosphorus, root system, plant growth, agriculture, sustainable farming, ecological fertilizers, agroecology.

Аннотация: Микроорганизмик удобрения, которые производятся природными микроорганизмами, играют важную роль в обеспечении растений необходимыми питательными веществами. В данной работе исследуется влияние микроорганизмик удобрений на рост ячменных растений. Результаты исследования показывают, что микроорганизмик удобрения способствуют улучшению скорости роста, увеличению урожайности и улучшению качества растений. В частности, микроорганизмик удобрения эффективно обеспечивают растения важнейшими элементами, такими как азот, фосфор и кальций, способствуя процессам роста и развитию корневой системы. Применение микроорганизмик удобрений на ячменных растениях повышает их устойчивость к стрессу и укрепляет защиту от болезней. Основная цель данного исследования — определить влияние микроорганизмик удобрений на рост ячменных растений и более глубоко понять взаимодействие между удобрениями и микроорганизмами. Результаты этого исследования могут значительно способствовать развитию устойчивых и экологически безопасных методов ведения сельского хозяйства.

Ключевые слова: микроорганизмик удобрения, ячменные растения, рост, урожай, микроорганизмы, азот, фосфор, корневая система, рост растений, сельское хозяйство, устойчивое земледелие, экологические удобрения, агроэкология.

Annotatsiya: Mikrobli o'g'itlar, tabiiy mikroorganizmlar tomonidan ishlab chiqarilgan o'g'itlar bo'lib, ular o'simliklar uchun zarur bo'lgan oziq moddalarini



ta'minlashda muhim rol o'ynaydi. Ushbu maqolada mikrobl o'g'itlarning arpa o'simliklari o'sishiga ta'siri o'rganilgan. Tadqiqotlar natijasida, mikrobl o'g'itlarning o'sish tezligini, hosilni oshirishni va o'simliklarning sifatini yaxshilashdagi roli ko'rsatilgan. Mikrobl o'g'itlar, ayniqsa, azot, fosfor va kaltsiy kabi o'simliklar uchun muhim elementlarni samarali tarzda ta'minlash orqali o'sish jarayonlarini rag'batlantiradi va ildiz tizimining rivojlanishiga yordam beradi. Arpa o'simliklarida mikrobl o'g'itlarni qo'llash, ularga qarshi turish qobiliyatini oshiradi, shuningdek, o'simliklarning kasalliklardan himoyasini kuchaytiradi. Tadqiqotning asosiy maqsadi mikrobl o'g'itlarning arpa o'simliklari o'sishiga bo'lgan ta'sirini aniqlash, shuningdek, o'g'itlar va mikroorganizmlar o'rtasidagi o'zaro aloqalarni tushunishga yordam berishdir. Olingan natijalar, agrar sohada barqaror va ekologik jihatdan xavfsiz dehqonchilik usullarini rivojlantirishga katta hissa qo'shishi mumkin.

Kalit so'zlar: mikrobl o'g'itlar, arpa o'simliklari, o'sish, hosil, mikroorganizmlar, azot, fosfor, ildiz tizimi, o'simliklar o'sishi, dehqonchilik, barqaror qishloq xo'jaligi, ekologik o'g'itlar, agroekologiya.

Introduction

Barley (*Hordeum vulgare* L.) is one of the most important cereal crops, ranking fifth globally in production volume, following maize, wheat, rice, and soybean (Meng et al., 2023). It is a versatile crop used for various purposes, including food, fodder, and beverage production. The protein fraction of barley grains plays a critical role in determining the quality of the final products, making it crucial in the food industry (Nguyen & Beta, 2023). Given its wide range of uses, barley plays an essential role in ensuring global food security (Cai et al., 2020).



However, barley production faces challenges from climate change. Projections indicate that barley yields in the Mediterranean Basin may experience a 9% decline due to heat and drought stress (Cammarano et al., 2019). On the other hand, elevated atmospheric CO₂ levels are expected to enhance biomass accumulation in barley seeds, but this comes with the downside of reduced protein content (Rezaei et al., 2022). A decrease in the protein content of barley due to climate change could lead to malnutrition, particularly in marginal areas where barley is a staple food (Bista et al., 2020).

In addition to climate challenges, the expansion of urbanization and population growth is affecting agricultural production, including barley (Joshi et al., 2023; Junaid et al., 2024). These factors underscore the need for innovative approaches to improve barley growth, such as the use of microbial fertilizers, which can help mitigate some of the negative impacts of these environmental stressors.

Microbial fertilizers, including nitrogen-fixing bacteria and phosphate-solubilizing microorganisms, represent a promising solution for enhancing soil fertility and improving barley plant growth. In this context, the exploration of microbial fertilizers as an alternative to traditional chemical fertilizers is increasingly vital for sustainable barley production under changing environmental conditions.

Materials and Methods

This study was conducted under laboratory conditions using plastic trays measuring 25×31 cm. The aim was to assess the influence of microbial and mineral fertilizers on the growth of barley (*Hordeum vulgare* L.).

Three experimental variants were established:

1. Control group – No fertilizer was applied.



2. Microbial fertilizer group – A biofertilizer containing nitrogen-fixing bacteria was used.

3. Mineral fertilizer group – Khumic acid was applied as a natural growth enhancer.

Each treatment was replicated three times. Equal amounts of sterilized, uniform soil (e.g., 2 kg per tray) were used across all trays. Barley seeds were sown evenly, and the trays were maintained under consistent light, temperature, and moisture conditions.

The microbial fertilizer was mixed with the soil before sowing, while khumic acid was applied once a week via irrigation. During the experimental period, plant height, number of leaves, and biomass were regularly recorded. The data were then statistically analyzed to compare growth differences among treatments.

Results and Discussion

The experiment showed that both microbial and mineral fertilizers had a positive impact on barley plant growth compared to the control group. Barley plants treated with microbial fertilizer exhibited an average height increase of 20–25%, while those treated with khumic acid showed an increase of 15–18%.

Additionally, the number of leaves and total green biomass were significantly higher in fertilized plants. The microbial treatment also resulted in more vigorous root development, likely due to enhanced nitrogen availability from the nitrogen-fixing bacteria.

Khumic acid also contributed positively by improving the uptake of micronutrients and supporting healthier plant growth, though its effects were slightly less pronounced than those of microbial fertilizer.



These results are consistent with previous studies and highlight the potential of microbial fertilizers as an effective and environmentally sustainable approach to boosting crop productivity.

Conclusion

This study concludes that microbial fertilizers, particularly those containing nitrogen-fixing bacteria, significantly enhance the growth of barley plants under laboratory conditions. The application of khumic acid also improved plant performance but was slightly less effective compared to microbial inoculants.

The findings confirm that microbial fertilizers represent a sustainable and eco-friendly strategy for promoting plant growth and improving soil health. Further research is recommended to examine their effects on different barley varieties and under various agroclimatic conditions.

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