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Yeast: A Potential Bio-stimulant for Plant Growth & Development

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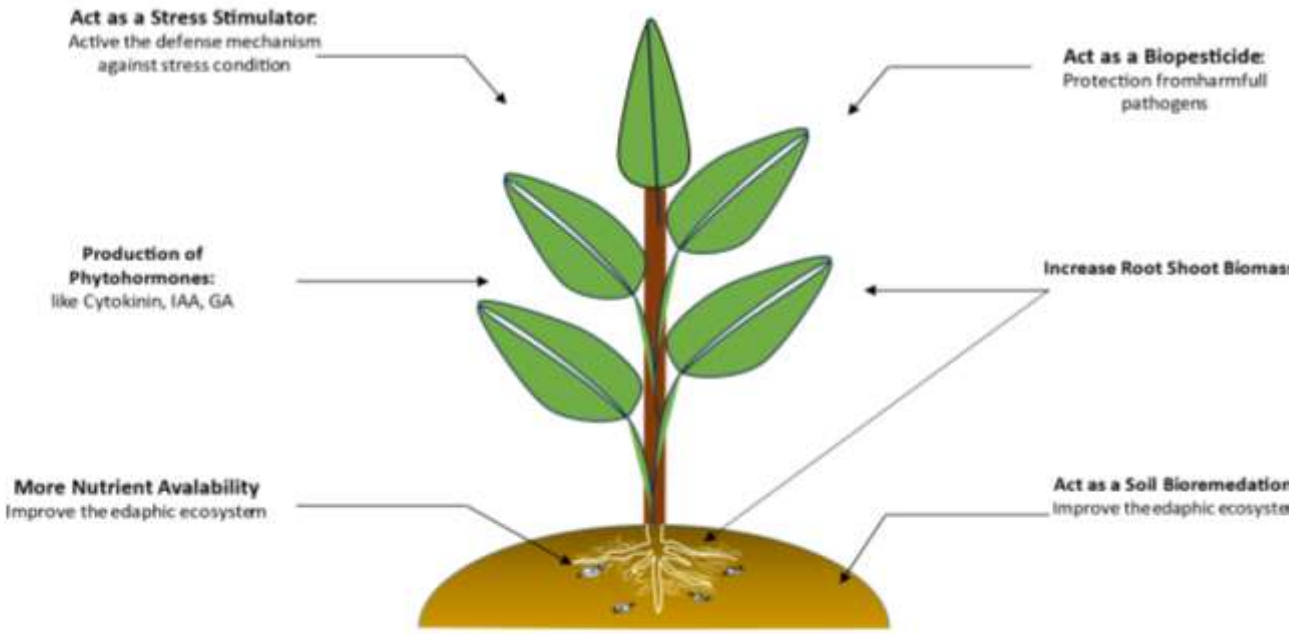
SUMMARY

This newsletter delves into the trans-formative impact of yeasts on plant growth and environmental sustainability. From bolstering biomass and nutrient availability to producing phytohormones, enabling biological control, and enhancing stress tolerance, yeasts emerge as vital contributors to Eco-friendly agriculture. Their diverse applications promise a sustainable future for enhanced crop productivity and global food security.

INTRODUCTION

Yeast, a single-celled fungi, has emerged as a powerful agent with the ability to significantly influence plant morphology and overall development. It has gained attention as a potential bio-stimulant for enhancing plant growth and development due to its unique properties including the ability to enhance nutrient uptake and promote stress tolerance in plants. Yeast is an attractive option for improving crop yields and overall agricultural productivity. Furthermore, yeasts play a crucial role in bolstering biomass and nutrient availability, producing phytohormones, enabling biological control, and enhancing environmental sustainability. By harnessing the transformative impact of yeast, agriculture can become more sustainable and contribute to global food security. The utilization of yeast in agriculture has proven to be a game-changer with significant benefits for plant growth! As concerns rise over the adverse effects of mineral fertilizers on both environmental and human health; exploring yeast's diverse benefits becomes increasingly promising by offering sustainable alternatives for enhanced crop production amidst growing global population demands (Hernández-Fernández *et al.*, 2021, Pandit *et al.*, 2022) The utilization of yeasts in agriculture has opened up new avenues for enhancing plant growth and development while promoting environmental sustainability.



Increased shoot and root biomass:

Increased shoot and root biomass suggests enhanced growth of the above ground (shoot) and below ground (root) parts of a plant. This is often a desirable outcome in agriculture, as it can indicate more robust plant growth and potentially higher yields. Various factors, such as optimized growing conditions, genetic factors, fertilization, and use of biofertilizers, can contribute to increased shoot and root biomass. The increased nitrogen and phosphorus content in plant tissues observed after introducing yeast can contribute to a greater root-to-shoot ratio and specific growth responses in different plant species. In the case of sugarcane, this can result in increased tillering, the process by which new shoots are produced, and in tomatoes, it can lead to greater shoot biomass. These findings underscore the potential of using yeast to improve plant nutrient uptake and overall plant performance (Lonhienne et al., 2014).

Enhanced nutrient availability:

Enhanced nutrient availability refers to the increased presence of essential elements in the soil, which plants can readily absorb to support their growth and development. When yeast is used as a biofertilizer, it can positively affect soil nutrient cycles by contributing to increased levels of available nitrogen (N) and phosphorus (P). This is due to the mineralization processes in the soil, where organic compounds are broken down into inorganic forms that plants can use. For example, yeast supplementation in the soil has been shown to increase CO_2 production, raise microbial biomass, and amplify certain enzyme activities that are involved in the breakdown of organic matter, leading to a higher content of available N and P. This nutrient boost can directly benefit plant nutrition, supporting more vigorous growth and potentially improved crop yields (Rezende et al., 2004) (Hernández-Fernández et al., 2021). Upon decomposition in the soil, yeast cells release both macro- and micronutrients that are essential for plant development. This nutrient release helps to stimulate robust plant growth, potentially allowing for a reduction in the need for synthetic fertilizers by 20–30%. By enriching the soil with an optimal balance of nutrients, including nitrogen, which is crucial for plant development, yeast can enhance the productivity of crops such as wheat. Using yeast in this manner aligns with sustainable agricultural practices, aiming to reduce reliance on chemical inputs and promoting healthier ecosystems while maintaining or improving crop yields.

Production of Phytohormones:

Yeasts can produce phytohormones, which are natural plant growth regulators. These substances include auxins, cytokinins, and gibberellins, which are essential for various plant growth processes, ranging from cell division and elongation to the timing of flowering and fruit development. For example, the yeast species *Williopsis saturnus* has been reported to produce auxins, specifically indole-3-acetic acid and indole-3-pyruvic acid, which, when introduced into the roots of maize plants, resulted in significant growth promotion. By producing these hormones endophytically, yeasts can directly influence plant growth and development, offering a natural method to boost plant health and crop yields. The use of yeasts for this purpose can potentially reduce reliance on synthetic growth promoters and align with the principles of sustainable agriculture by offering an environmentally friendly alternative (Hernández-Fernández et al., 2021).

Biological Control:

Yeasts are indeed effective as biocontrol agents due to their diverse set of antagonistic mechanisms against various plant pathogens. By competing for space and nutrients, producing antimicrobial toxins, and inducing systemic resistance in plants, yeasts can suppress the growth of harmful fungi and other pathogens. Biocontrol tests have shown that many strains of wild yeast have an inhibitory effect on the growth of mycotoxigenic molds (García-Béjar et al., 2020). Moreover, yeasts such as Saccharomyces and non-Saccharomyces species have been identified as potential antagonists against phytopathogens like Penicillium, Aspergillus, and Botrytis cinerea (Pandit et al., 2022). These natural antagonistic activities position yeasts as an eco-friendly alternative to chemical pesticides. Not only can they act as biofungicides, but research is also exploring their potential as bioinsecticides and bioherbicides. The application of yeasts as biological control agents can thus contribute to a more sustainable and integrated pest management approach in agriculture.

Stress Tolerance Boost:

Yeasts indeed play a crucial role in enhancing plant tolerance to various environmental stresses, such as drought, salinity, and extreme temperatures. By treating plants with yeasts, plants can trigger their defense mechanisms, which includes accumulating osmoprotectants like proline and activating antioxidant enzymes that help mitigate the detrimental effects of stress. This is illustrated by the application of yeasts in improving the oxidative defense system of salt-stressed flax seedlings, leading to better germination and growth under high salt conditions (Emam, 2013). Moreover, yeast-based applications have been found to possess additional benefits such as antagonistic effects against phytopathogens, which can provide biological control against certain plant diseases. Using yeasts as biocontrol agents can be part of an eco-friendly strategy that promotes plant health while possibly reducing dependency on chemicals (Pandit et al., 2022). Furthermore, the capability of yeasts to absorb toxins, including heavy metals from the soil, contributes to bioremediation, adding a dimension of soil health improvement and environmental management to the use of yeasts in agricultural settings (Pandit et al., 2022) (Emam, 2013). These multifaceted benefits position yeasts as valuable tools in sustainable agriculture.

Soil Bioremediation:

Yeasts have been shown to enhance plant stress tolerance to various environmental challenges, including drought, salinity, and extreme temperatures. The application of yeast can trigger plant defense mechanisms, such as the accumulation of osmoprotectants and the activation of antioxidant enzymes, which help plants to cope with stress conditions. Indeed, yeasts can play a significant role in enhancing plant stress tolerance. They aid in mitigating stresses such as salinity by accumulating osmoprotectants, which include free amino acids like proline, and by activating the plant's oxidative defense system with components such as ascorbic acid, glutathione, and total phenols. These mechanisms help in preventing membrane peroxidation and in improving the germination and growth of seedlings under harsh conditions like severe salt stress (Emam, 2013). For example, in salt-stressed flax seedlings, yeast treatments were shown to mitigate salinity stress, leading to increased production of osmoprotectants like free amino acids, specifically proline, as well as elevating the plant's defense system in terms of ascorbic acid, glutathione, and total phenol content. This defense response helps protect plants against oxidative damage, improving germination rates and enhancing seedling growth under high salt stress (Pandit et al., 2022). Apart from elevating a plant's innate stress response, yeasts can also help in bioremediation by absorbing toxins and heavy metals from the soil. This not only assists plants in coping with metal toxicity but also contributes to soil health, making yeast-based treatments a beneficial tool in sustainable agriculture and environmental management. For instance, specific yeast strains have been identified for their capacity to biodetoxify substances such as aflatoxin B1 and zinc, as demonstrated by techniques like HPLC and voltammetry. Some yeast species, like *Rhodotorula mucilaginosa* and *Diutina rugosa,* showed significant detoxification abilities, removing over 50% of these contaminants. This process benefits the surrounding plants by reducing metal toxicity and contributes to improving soil health. Such mechanisms enhance the feasibility of using yeasts in sustainable agriculture practices and ecological restoration efforts (García-Béjar et al., 2020).

CONCLUSION

In summary, the potential of yeast as a bio-stimulant for plant growth and development is substantial and multifaceted. The application of yeast can lead to enhanced growth parameters such as increased biomass, improved nutrient uptake, and elevated production of phytohormones, all of which contribute to healthier and more vigorous plants. Moreover, yeasts serve as efficient biological control agents, offering natural protection against various plant pathogens through antagonistic mechanisms and induced systemic resistance. Additionally, yeast's contribution to stress tolerance, including mitigating the effects of drought, salinity, and heavy metal toxicity, further consolidates its role as an ally in agriculture. As the agricultural sector continues to seek sustainable and eco-friendly alternatives to traditional chemical inputs, yeast stands out as a promising candidate, poised to play a significant role in the future of crop cultivation and environmental stewardship.

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