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GLUCANS AS PLANT IMMUNITY BOOSTERS

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Introduction

Plants face constant threats from pests, diseases, and harsh conditions like drought and extreme temperatures, leading to massive crop losses 20-40% globally each year. These losses strain food production and risk food security worldwide. While chemical pesticides are common, they harm health and the environment. Sustainable solutions like resistant crop varieties, trap crops, and beneficial microbes offer safer alternatives. Another promising approach is using plant immune boosters, such as β-glucan, a natural compound that strengthens crops against diseases and stress. β-glucan works by activating plants defense systems, helping them resist infections and environmental challenges. Unlike synthetic chemicals, it's eco-friendly and supports long-term soil and crop health. By adopting natural solutions like β-glucan, farmers can protect yields, reduce chemical use, and promote sustainable agriculture for future generations.

Types of glucans

Glucans are a specific type of glycan composed entirely of glucose molecules bonded in different ways. Glucans are versatile polysaccharides categorized primarily as β-glucans and α-glucans, each with unique structures and transformative applications. β-glucans, characterized by β-(1→3), β-(1→4), or β-(1→6) linkages, are abundant in cereal grains, fungi, and yeast. These bioactive molecules are pivotal in immunomodulation making them invaluable in the nutraceutical pharmaceutical, and functional food industries. In contrast, α-glucans, such as starch and glycogen, consist of α-(1→4) and α-(1→6) linkages, serving as primary energy storage molecules in plants and animals. Their applications extend to food technology, renewable biofuels, and biodegradable materials. The specific bonding patterns dictate their solubility, structural integrity, and bioactivity β-(1→3)-linked glucans are potent in immune activation, while α-(1→4)-linked starch forms the cornerstone of human nutrition and industrial starch-based innovations. Their different structures give them unique benefits: β-glucans support health, while α-glucans fuel our bodies and industries. By using both types, we can enhance nutrition, medicine, and sustainable products for a healthier future.

Glucans in Action: Unveiling Plant Defense

Oligosaccharides were discovered to be important signalling molecules, later called oligosaccharins. This key idea helped scientists understand that glycans play a major role in plant defense systems. Over the years, research has greatly expanded, revealing how glycans activate plant immunity. One of the first findings showed that oligogalacturonides broken-down pieces of plant pectin act as damage signals (DAMPs) that trigger strong immune reactions in plants. Recent progress has uncovered new bioactive glycans and their complex roles in starting and fine-tuning plant immune responses. These discoveries highlight how vital oligosaccharides are in plant defense and open new possibilities for using glycan-based solutions in eco-friendly farming.

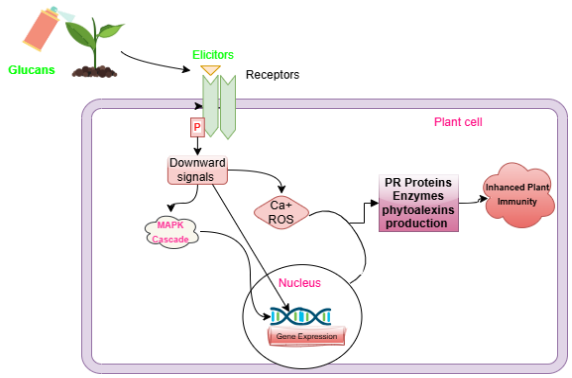

Figure 1. Mechanism of action of glucan as elicitor

One such elicitor is β-glucan, a natural polysaccharide derived from fungi, bacteria, algae, and cereals. β-glucan acts as a biological elicitor by stimulating systemic acquired resistance (SAR) and induced systemic resistance (ISR) pathways. Upon recognition by plant receptors, it activates defense signalling cascades, leading to the production of pathogenesis-related proteins, reactive oxygen species, and antimicrobial compounds (Fig.1). Studies have demonstrated that β-glucan application enhances crop resistance to diseases, reduces post-harvest losses, and minimizes environmental impact compared to synthetic chemical treatments. Using β-glucan and other plant defense boosters offers a sustainable way to strengthen crops, reduce crop damage, and improve food production. Its effects depend on their structure. Some plants (Tobacco and Barley) react better to longer chains, while others (Arabidopsis) respond more to shorter ones. Overall, the way β-1,3-glucans work depends on their shape, modifications, and the specific plant being treated. This approach helps address challenges like climate change and a growing population while ensuring stable food supplies.

Glucans are helping farmers fight plant diseases naturally. In Rice farming blast fungus, which destroys harvests control by simple rice bran glucan spray which reduced the disease by 30-50%. After adding seaweed glucans to watering system, mold infections fell by 40% in just two months in tomatoes. In California, a grape grower used a glucan spray and cut powdery mildew infections by half. Banana farmers in Ecuador mixed glucans into the soil and reduced deadly *Fusarium* wilt by 70%. These real successes prove glucans work giving farmers an affordable, chemical-free way to protect their crops and boost yield.

Using glucans in agriculture offers significant benefits, including a reduced need for chemical pesticides, providing a more sustainable farming solution. Glucans enhance crop resilience by strengthening plants natural defenses against diseases and pests. Additionally, they promote healthier plant growth, leading to improved yields and higher-quality fruits or grains. This makes glucans a valuable tool for eco-friendly and productive agriculture. We can apply glucans in farming and gardening by using ready-made glucan biostimulants. The best ways to use them are by spraying on leaves (foliar spray) or watering into the soil (soil drench) to help plants grow stronger and healthier.

Suggested readings

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