Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 05, Issue: 02 (MAR-APR, 2025)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Endophytes' Contribution to Improving Seed Quality in Seed Production

(*Nailendra Oram, Mahesh Sahu, Pratyush Ranajan Padhan and Saikriti Nayak)
M. Sc. Scholar, Department of Seed science and technology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, 751003, Odisha
*Corresponding Author's email: nailendraoram2580@gmail.com

Plant tissue-colonizing symbiotic bacteria known as endophytes play a major role in improving seed quality and yield. Through the release of extracellular enzymes, physiologically active metabolites, and phytohormones, they enhance seed vigour, germination, and tolerance to biotic and abiotic stress. They contribute to improved seedling establishment by facilitating nutrient uptake, phosphate solubilisation, and the synthesis of growth-stimulating chemicals. Because endophytes increase tolerance to stress, seeds can operate as efficiently as possible in stressful environmental circumstances like salinity and drought. Their use in biocontrol, biofertilization, and seed priming guarantees ecologically benign methods of producing high-quality seeds. The role of microbial endophytes to improving seed technology and sustainable agriculture is highlighted in this review.

Endophytes and their Role in Seed Quality Enhancement

Endophytes contribute to seed quality by producing essential plant hormones such as auxin, abscisic acid (ABA), ethylene, gibberellic acid (GA3), and indole-3-acetic acid (IAA). These hormones regulate seed germination and vigour, ensuring robust seedling establishment. Additionally, endophytes facilitate nutrient acquisition, thereby improving seed nutrition and enhancing seedling growth post-germination. Their ability to solubilize phosphate and fix nitrogen further strengthens seedling development. Microbial endophytes also enhance seed defence mechanisms, enabling them to withstand environmental stresses such as drought, salinity, temperature fluctuations, and heavy metal contamination. Through the production of extracellular enzymes, these microbes colonize the seed effectively and support better seedling emergence and growth.

Endophytes in Seed Germination and Vigour Improvement

Rosada (2017) conducted an experiment to examine the presence of seed endophytes in ten different genotypes of green gram (*Vigna radiata*). The study assessed the effect of biopriming with these endophytes on seedling vigour. Among the seed treatments, the variety DGGV-2 exhibited the highest germination rate (89.79%) and vigour index (3874) under laboratory conditions. Furthermore, seeds treated with the isolate AUUB 456 demonstrated higher germination (87.90%) and vigour index (3649) compared to those treated with other isolates. Notably, the interactions of varieties and isolates (V × I) such as DGGV-2 with AUUB 417 and DGGV-2 with AUUB 433 also resulted in significantly higher vigour index, indicating the potential of seed endophytes in improving seedling quality.

Endophytes for Enhancing Seed Quality in Maize

Gayathri et al. (2020) conducted an experiment to evaluate the effect of seed endophytic treatment on maize (*Zea mays* L.) quality. Their study analyzed the impact of *Bacillus subtilis*, *Metarhizium anisopliae*, and *Beauveria bassiana* on seed germination, seedling

length, and vigour index. The findings revealed that treating maize seeds with *Metarhizium anisopliae* at a concentration of 5% resulted in the most significant improvement in seed quality parameters, surpassing other treatments. These results underscore the importance of endophytes in promoting healthier and more resilient seeds through seed enhancement techniques.

Endophyte-Seed Priming for Stress Resistance in Sorghum

Channappagoudar (2022) explored the effect of seed priming with endophytes on seed quality, abiotic stress resistance, and seed health in rabi sorghum (*Sorghum bicolor* L.). The study examined five different isolates for their multifunctional activities, including IAA production, phosphate solubilization, and GA production. Among them, *Staphylococcus edaphicus* (AUST 3) and *Myroides odoratimimus* (AUST 20) emerged as the most promising isolates for enhancing seed quality under moisture and salt stress conditions. This research highlights the ability of endophytes to improve seed stress tolerance, which is critical for ensuring stable seed production in challenging environments.

Mechanisms of Seed Quality Enhancement by Endophytes

Endophytes contribute to seed quality enhancement through various mechanisms:

1. **Phytohormone Production:** They produce essential growth hormones such as IAA, ABA, and GA3, which regulate seed germination and vigour.
2. **Nutrient Acquisition:** By fixing nitrogen and solubilizing phosphate, endophytes improve seed nutrient content, supporting early seedling growth.
3. **Extracellular Enzyme Production:** These enzymes help endophytes colonize seeds effectively, enhancing seedling emergence and establishment.
4. **Induction of Systemic Resistance:** Some endophytes activate the seed's defense mechanisms, improving resistance to pathogens and pests.
5. **Moisture and Salinity Stress Resistance:** Endophytes contribute to osmotic adjustment, improving seed survival under water-deficient and saline conditions.

Applications of Endophytes in Seed Production

With the growing demand for high-quality seeds, endophytes are gaining attention for their potential applications in seed enhancement and seed industry:

1. **Biopriming Agents:** Endophytes improve seed germination rates and seedling vigour, ensuring better crop establishment.
2. **Biofertilizers:** Endophytic bacteria and fungi enhance seed nutrition by improving nutrient availability.
3. **Biocontrol Agents:** They suppress seed-borne pathogens, reducing the need for chemical seed treatments.
4. **Stress Management in Seed Production:** Endophytes enhance seed tolerance to drought, salinity, and temperature extremes, ensuring high seed quality under challenging environmental conditions.

Conclusion

The microbial endophytic community plays a crucial role in enhancing seed quality, promoting seed vigour, and improving stress tolerance. By producing phytohormones, extracellular enzymes, and stress-related compounds, endophytes protect seeds from adverse conditions and ensure better germination and seedling establishment. The research conducted by Rosada (2017), Gayathri et al. (2020), and Channappagoudar (2022) highlights the potential of endophytes in improving seed quality for better crop productivity. Future seed production practices should incorporate endophyte-based technologies to enhance seed quality and sustainability in agriculture.

References

1. Channappagoudar R. M. (2022). Effect of seed priming of endophytes on seed quality, abiotic stresses, and seed health management in rabi sorghum (*Sorghum bicolor* L.). Ph.D. Thesis, University of Agricultural Science, Dharwad, Karnataka, India.
2. Gayathri M., Jerlin R., Kennedy J. S., & Sasthri G. (2020). Seed endophytic treatment for enhancing seed quality in maize (*Zea mays* L.). *Multilogical in Science, 10*(12), 1108-1112.
3. Rosada J. V. (2017). Biopriming with seed endophytes and its effect on seedling vigour in greengram (*Vigna radiata* L.). M.Sc. (Agri.) Thesis, University of Agricultural Science, Dharwad, Karnataka, India.