Journal of Plant Biochemistry & Physiology

OPEN ACCESS Freely available online

Perspective

Asexual Seed Formation: Unlocking the Potential of Apomixis in Agriculture

Joyce Koena*

Department of Plant Biology, Fudan University, Shanghai, China

DESCRIPTION

Apomixis, the asexual reproduction through seeds, has gained significant attention in plant biotechnology due to its potential to enhance crop breeding and improve agricultural productivity. By enabling the generation of genetically identical offspring, apomixis offers a solution to the limitations of traditional sexual reproduction, such as the loss of beneficial traits in subsequent generations. Inducing apomixis in crop plants could revolutionize agriculture by ensuring uniformity in hybrid seeds and enabling the conservation of desirable genetic traits. This article explores the current strategies and innovations in inducing apomixis in crop plants through biotechnological approaches.

Apomixis and its potential

Apomixis involves the formation of seeds without fertilization, and it occurs naturally in certain plant species. In apomictic plants, the embryo develops from an unfertilized egg cell, bypassing the normal process of fertilization. The result is offspring that are genetically identical to the mother plant. This phenomenon holds significant potential for crop improvement, as it allows the perpetuation of elite hybrid varieties without the need for recurrent hybridization. However, inducing apomixis in crop plants that do not naturally exhibit this trait remains a complex challenge. The molecular mechanisms underlying apomixis are still not fully understood, and its induction in species that rely on sexual reproduction requires precise manipulation of plant developmental pathways.

Current strategies in inducing apomixis

Several biotechnological approaches are being explored to induce apomixis in crop plants, including genetic engineering, genome editing, and somatic embryogenesis.

Genetic engineering and transgenic approaches: One of the primary methods for inducing apomixis involves the genetic modification of plants to express key genes associated with apomictic processes. By introducing genes from naturally apomictic species into sexually reproducing crops, researchers aim to mimic the molecular pathways involved in apomixis. For example, genes involved in the formation of unreduced gametes or the activation of the agamospory pathway (a form of apomixis) are being transferred into species like maize, wheat, and rice. These genetic modifications help in bypassing the need for fertilization, allowing the seed development to proceed asexually.

CRISPR/Cas9 genome editing: The advent of CRISPR/Cas9 technology has enabled precise genome editing, offering a powerful tool for inducing apomixis in crops. By editing specific genes related to meiosis or the regulation of gametogenesis, scientists can modify the reproductive process in plants. For instance, altering the expression of genes involved in the production of unreduced gametes or modifying pathways controlling the transition from sexual reproduction to apomixis can potentially lead to the development of apomictic crops. CRISPR/Cas9 can also be used to knock out genes that prevent apomixis in species where the trait does not naturally occur.

Somatic embryogenesis and tissue culture: Somatic embryogenesis, the process by which somatic cells are induced to form embryos, is another approach being explored for inducing apomixis. In this method, researchers manipulate plant tissue cultures to develop embryos that can produce seeds without fertilization. The technique has been particularly promising in species like Arabidopsis and some grasses. However, the challenge lies in achieving consistent and efficient induction of somatic embryogenesis and ensuring the apomictic nature of the resulting seeds.

Innovations and future directions

Recent advances in the understanding of the molecular basis of apomixis have opened up new avenues for inducing the trait in crop plants. Innovations such as the use of epigenetic modifications and RNA interference (RNAi) to regulate gene expression are being investigated as potential tools for controlling apomixis in crops. Additionally, research into the role of small RNAs in regulating apomictic pathways offers

exciting possibilities for the development of apomictic plants

Correspondence to: Joyce Koena, Department of Plant Biology, Fudan University, Shanghai, China, E-mail: koena_joyce@gmail.com

Received: 03-May-2024, Manuscript No. JPBP-24-35192; **Editor assigned:** 06-May-2024, PreQC No. JPBP-24-35192 (PQ); **Reviewed:** 20-May-2024, QC No. JPBP-24-35192; **Revised:** 27-May-2024, Manuscript No. JPBP-24-35192 (R); **Published:** 03-Jun-2024, DOI: 10.35248/2329-9029.24.12.299

Citation: Koena J (2024). Asexual Seed Formation: Unlocking the Potential of Apomixis in Agriculture. J Plant Biochem Physiol.12:299.

through non-transgenic approaches. Furthermore, the integration of genomics, transcriptomics, and proteomics is helping identify key regulatory genes involved in apomixis, which could facilitate the development of more efficient strategies for crop improvement.

CONCLUSION

Biotechnological approaches to inducing apomixis in crop plants are progressing rapidly, offering the potential to revolutionize crop breeding and agricultural practices. While significant challenges remain in understanding the complex genetic and molecular mechanisms behind apomixis, current strategies such as genetic engineering, genome editing, and somatic embryogenesis hold great promise. With continued research and innovation, apomixis could play a pivotal role in enhancing food security by providing a sustainable and efficient method for crop propagation, ensuring genetic stability, and improving crop yields.