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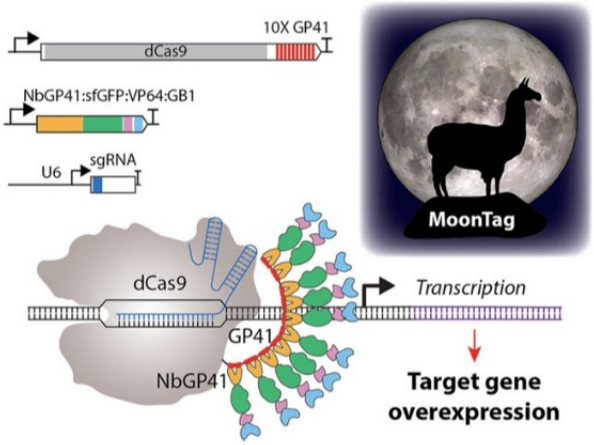
MoonTag and plant-derived activation domains for improved genetic engineering

A novel programmable transcriptional activator that can work with plant-derived activation domains to enable precise and robust gene activation in plants.



IP Status: PCT Pending, US Patent Pending; Application No. 18/862,329 and 18/708,411

Applications

- Crop engineering
- Engineered genetic incompatibility
- Biotherapeutics

Key Benefits & Differentiators

- **Increased stability:** The MoonTag system is more stable in transgenic plants compared to previous systems like SunTag
- **Plant-derived activation domains:** New activation domains (DREB2, DOF1) outperform VP64 with up to 3 fold higher transcription activation
- **Temperature resilience:** Functional across a broad range of growth temperatures which is essential for potential field applications.

Technology Overview

CRISPR-based transcriptional activators have revolutionized gene activation by enabling targeted overexpression of plant genes. SunTag, a second-generation system, activates transcription by recruiting multiple copies of an activation domain to its target promoters. Although SunTag is a strong activator, it is difficult to stably express in some species, thus limiting its applications. Additionally, CRISPR-Cas activators have traditionally relied on non-plant-derived activation domains, such as VP64, which has limited activation efficiency and

Technology ID

2022-087, 2022-150

Category

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Life Sciences/Research Tools
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poses potential regulatory challenges.

To address these problems, researchers at the University of Minnesota have developed a robust programmable transcriptional activator, MoonTag, and novel plant-derived activation domains DREB2 and DOF1. MoonTag uses a nanobody NbGP41 and a GP41 peptide pair to mediate the recruitment of the activation domain. MoonTag demonstrates strong performance in monocots (Setaria) and dicots (Arabidopsis and tomato) and functions across a broad temperature range, making it suitable for field applications. By incorporating plant-specific activation domains such as DREB2 and DOF1, MoonTag delivers up to threefold higher gene activation than VP64. With MoonTag's enhanced stability and the exceptional activity of novel plant-derived activation domains, these tools represent a significant advancement in precise and robust genetic engineering of plants.

Phase of Development

TRL: 3-4

Successfully validated in transgenic Arabidopsis plants with observable phenotypic changes. Other species that MoonTag has been demonstrated in include: Setaria (grasses), corn, tomato, tobacco, pennycress, and camelina.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

- **Michael Smanski, PhD** Associate Professor, Department of Biochemistry, Molecular Biology, and Biophysics
- **Daniel Voytas, PhD** McKnight Presidential Endowed Professor, Department of Genetics, Cell Biology, and Development

References

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