Uses a Nonpathogenic Streptomyces Species to Produce Industrial-Scale Thaxtomin for Herbicidal Applications

Thaxtomin is a toxin produced by *Streptomyces* species of bacteria that causes plant cell death by inhibiting the synthesis of cellulose, the major component of a plant’s cell wall. This naturally occurring toxin is a desirable candidate to develop into an organic herbicide for weed control. However, a major impediment to commercializing thaxtomin is that the species of *Streptomyces* that produces this toxin is pathogenic and the levels of thaxtomin produced fall well below what is needed for cost-effective manufacture.

Researchers at the University of Florida have succeeded in transferring the cluster of genes responsible for biosynthesis of thaxtomin into a nonpathogenic *Streptomyces* strain. Additionally, they have engineered the gene cluster to eliminate the need to use an expensive component of culture media previously required to promote thaxtomin biosynthesis. The end result is nonpathogenic *Streptomyces* strains capable of producing thaxtomin at levels that make commercial production far more cost-effective.

Application

Engineered nonpathogenic *Streptomyces* species that produces thaxtomin in higher yields, making commercial production more cost-effective

Advantages

- Utilizes a nonpathogenic strain of *Streptomyces* species to produce thaxtomin, avoiding safety concerns associated with pathogenic *Streptomyces* species
- Produces much higher levels of thaxtomin, leading to lower, more cost-effective production
Technology

*Streptomyces scabiei* is a plant pathogen that kills host cells with thaxtomin, a secreted toxin. A biosynthetic gene cluster located on a mobile genomic island enables and regulates the production of thaxtomin. UF scientists mated *S. scabiei* with nonpathogenic *Streptomyces* species, which resulted in the acquisition of the thaxtomin biosynthetic cluster by nonpathogenic *Streptomyces* species. Most of the recipient *Streptomyces* species either did not produce thaxtomin or produced lower amounts than *S. scabiei* upon the acquisition of the thaxtomin cluster, indicating that the genetic backgrounds of recipients affect thaxtomin production considerably. However, *S. albus* J1024 produced a significantly higher concentration of thaxtomin in comparison to *S. scabiei*, and the engineered strain is suitable for the heterologous production of thaxtomin for commercial applications. Additionally, researchers refactored the biosynthetic gene cluster and controlled the expression of the cluster to exclude cellobiose in thaxtomin production, greatly reducing production costs.

Inventors

**Rosemary Loria, Ph.D.,** is the chair of the Department of Plant Pathology at the University of Florida. Dr. Loria earned her Ph.D. in plant pathology from Michigan State University in 1980. Her research interests include the evolution and molecular mechanisms of plant pathogenesis in *Streptomyces* species.

**Yucheng Zhang,** is a graduate research assistant in Dr. Rosemary Loria’s lab. He earned his master’s and bachelor’s degrees in viticulture and enology at Northwest A&F University. Mr. Zhang’s research interests include identifying additional components involved in thaxtomin induction and regulation by *Streptomyces* scabies.

**Yousong Ding, Ph.D.,** is an assistant professor in the College of Pharmacy at the University of Florida. Dr. Ding earned his Ph.D. in medicinal chemistry from the University of Michigan in 2010. He then completed a postdoctoral fellowship at the California Institute of Technology and worked as a principal scientist at Pfizer. Dr. Ding’s research interests include discovering and developing small molecules and biologics as new therapeutic leads to address significant unmet medical needs.

**Guangde Jiang,** is a third year graduate research assistant in Dr. Loria’s lab. Mr. Jiang earned his master’s degree in medicinal chemistry at China Pharmaceutical University.

Contact:

<table>
<thead>
<tr>
<th>John Byatt</th>
<th>352-392-8929</th>
<th><a href="mailto:jbyatt@ufl.edu">jbyatt@ufl.edu</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>UF #16726</td>
<td>Patent Pending</td>
<td></td>
</tr>
</tbody>
</table>

**UF Office of Technology Licensing**

**UNIVERSITY of FLORIDA**

[www.otl.ufl.edu](http://www.otl.ufl.edu)