

# Diversity in mycotoxin biodegradation vs. detoxification within Actinobacteria: create no greater evil

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## Introduction

Fungal contamination of crops cannot only lead to lowered nutritional value, but also poses a serious health threat as the fungi can produce **mycotoxins**. This wide range of secondary metabolites can cause health problems ranging from vomiting to cancer and even death. Next to prevention of fungal contamination, and lowering the disease pressure once the fungus is already present, a huge effort is made to find solutions to **remediate contaminated batches**.

In this research, we focus on the non-steroidal estrogenic mycotoxin zearalenone. This toxin, harbouring a macrocyclic lactone ring and a benzene moiety, can bind to the estrogenic receptor, thus causing hyperestrogenic issues such as infertility. As Actinobacteria are known for the degradation of recalcitrant pollutants such as polyaromatic hydrocarbons, they offer great potential for **bioremediation of zearalenone**. Here, we present a screening of fifty-three Actinobacteria for the degradation and detoxification of zearalenone.

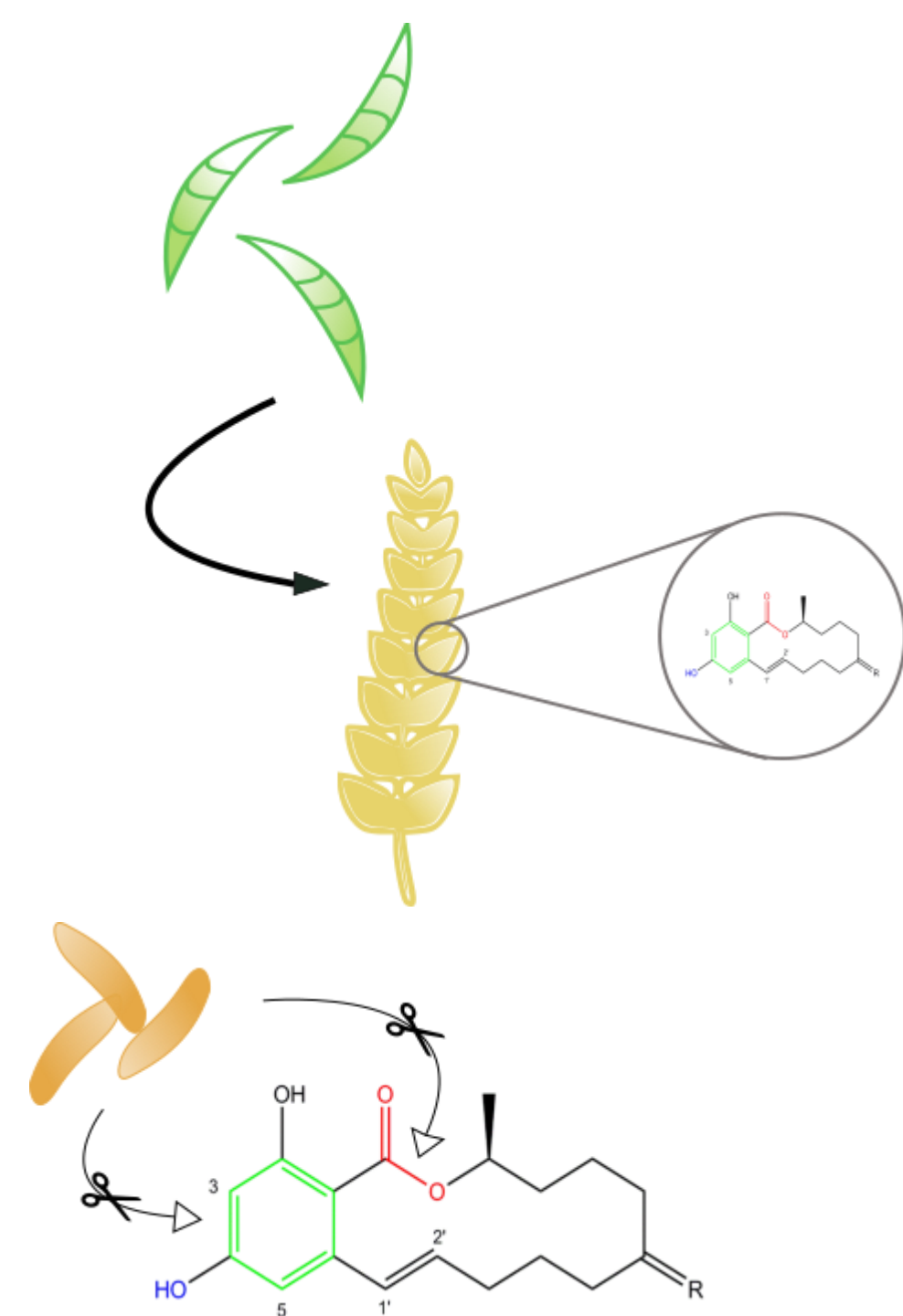
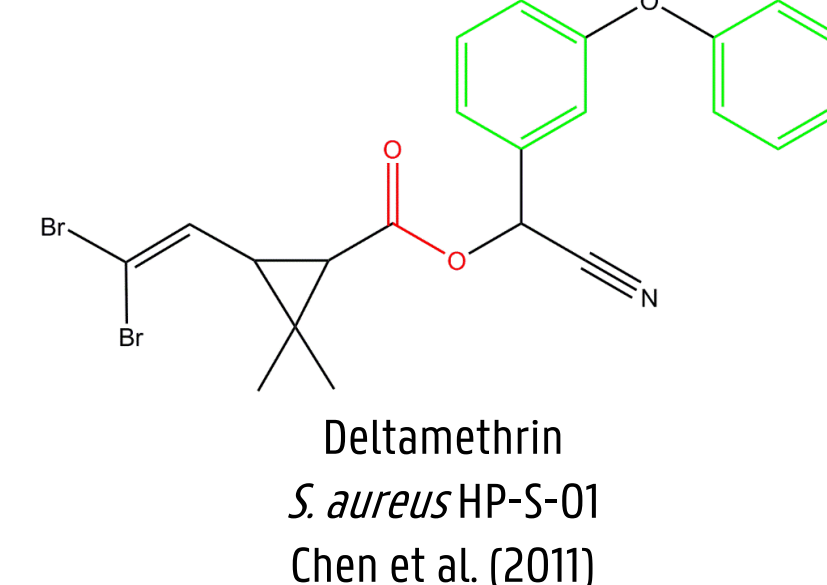
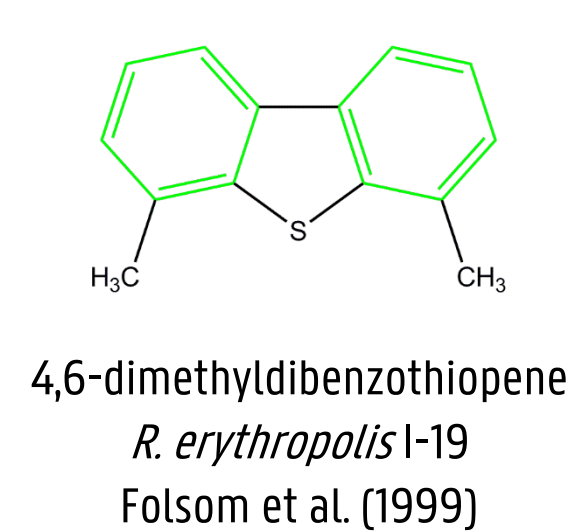
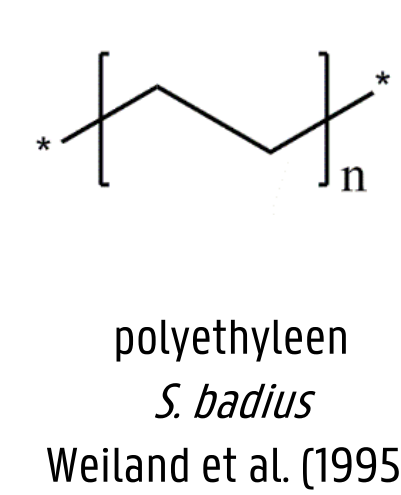
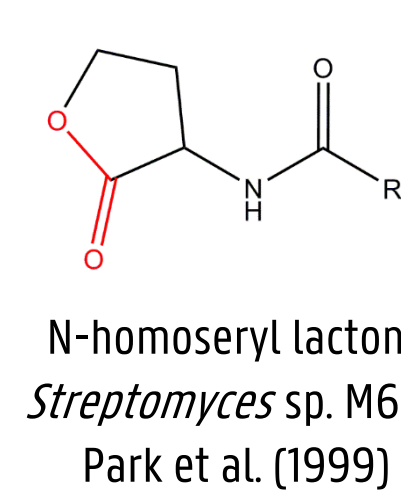
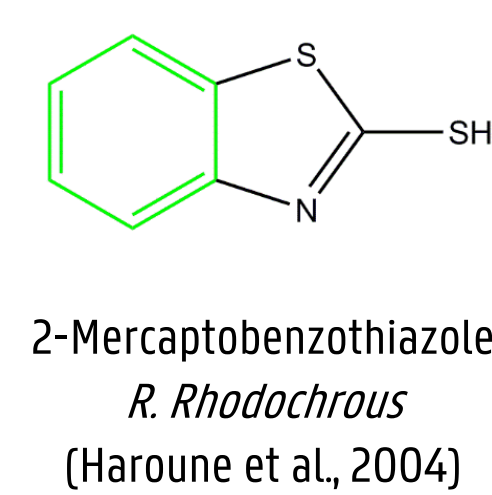


Figure 1: Infection with *Fusarium* spp. can lead to contamination with zearalenone, which Actinobacteria might break down.

## Actinobacteria: Catabolic masters

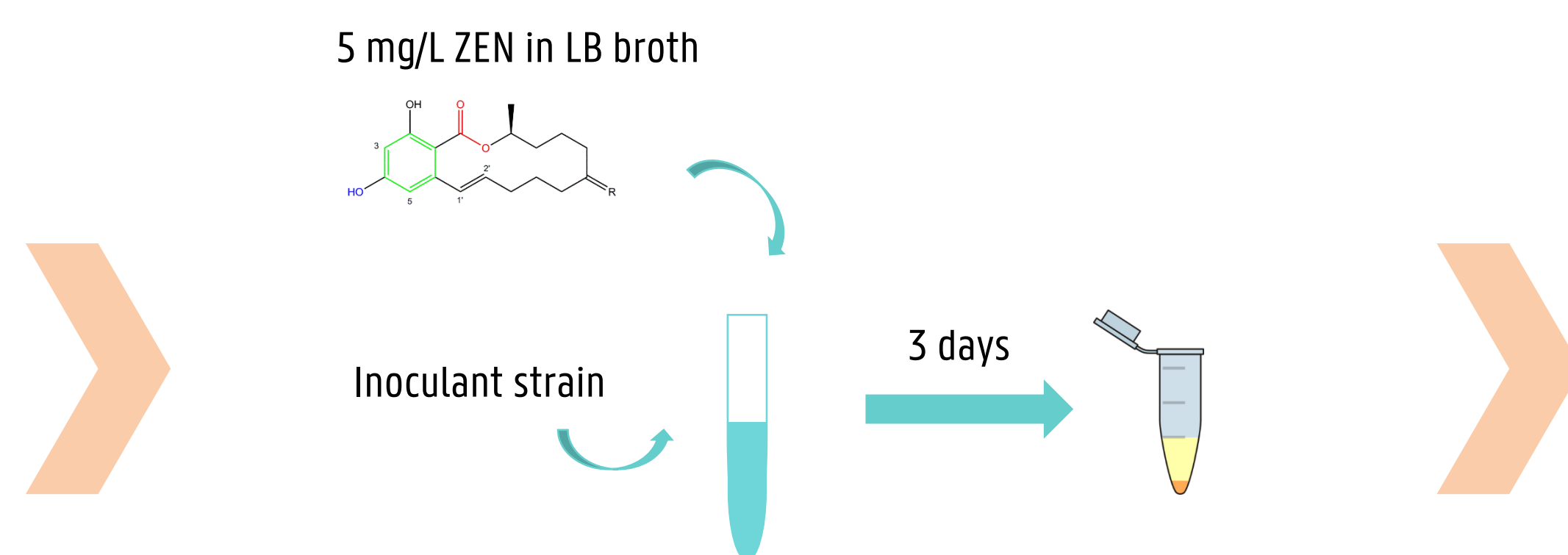
Actinobacteria have been shown to degrade a wide variety of recalcitrant pollutants.



## Screening workflow

Dereplication of strain collection by protein profiling with MALDI-TOF

Out of 81 analysed strains, 53 were selected for screening in a degradation assay.



Degradation?

HPLC-FLD and LC-MS/MS

Check for known metabolites  
 $\alpha$ -ZOL,  $\beta$ -ZOL,  $\alpha$ -ZAL,  $\beta$ -ZAL

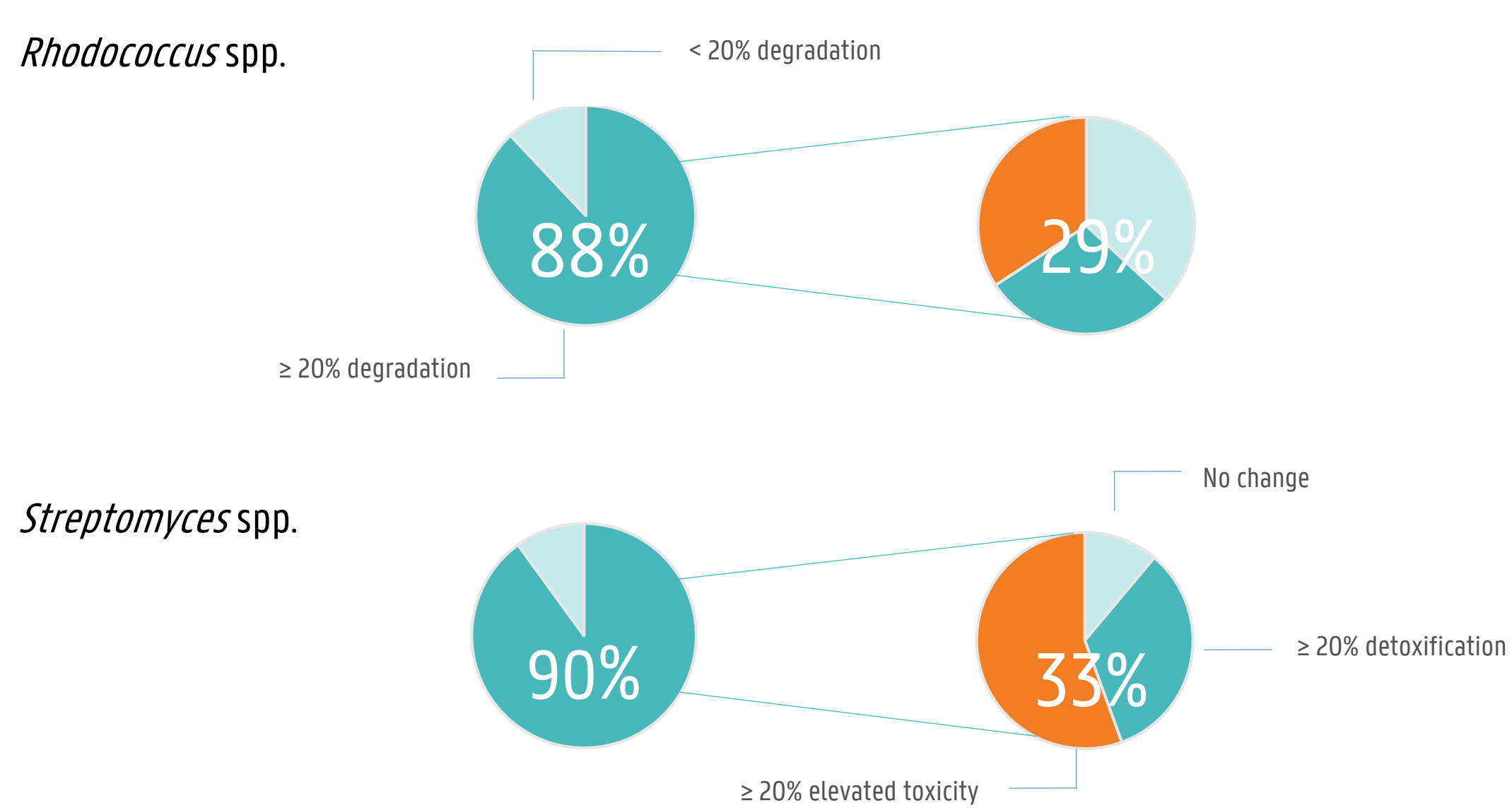
Detoxification?

BLYES/BLYR assay

Estrogenic receptor coupled to luminescence genes

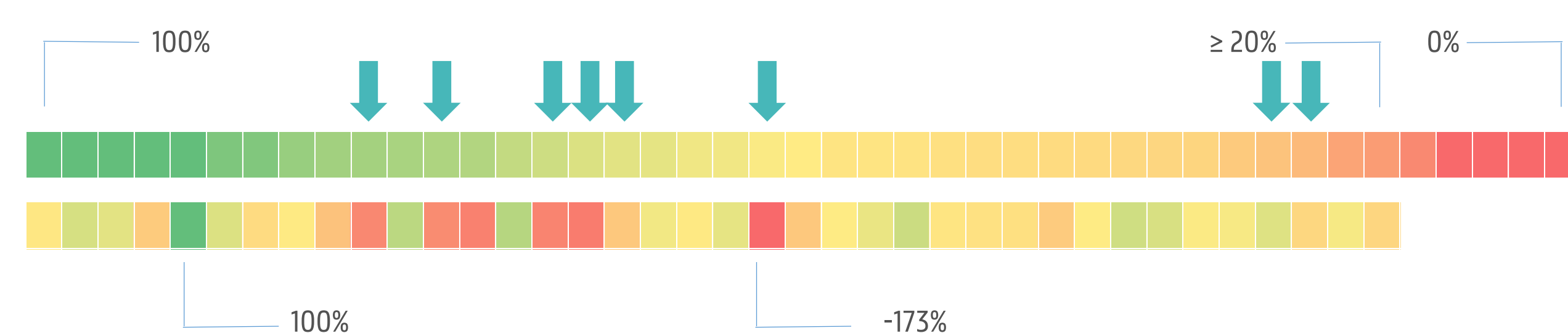
## Results

Degradation of ZEN can lead to either a decrease or an increase in estrogenic toxicity



**Overview of screening results.** Forty-three *Rhodococcus* spp. and ten *Streptomyces* spp. were screened for the degradation and detoxification of ZEN. Eighty-eight and ninety percent respectively showed at least 20% degradation, of which only 29 and 33% was associated with at least 20% detoxification.

Higher estrogenic toxicity is not always related to known estrogenic metabolites



**Specific results for the 43 screened *Rhodococcus* spp.** The upper bar represents the strains arranged by decreasing degradation percentage. The lower bar shows the detoxification (ranging from 100% to -173% or 73% increased toxicity). Each detoxification box is linked with the degradation box above it, highlighting that degradation and detoxification do not go hand in hand. Blue arrows indicate samples where either only  $\beta$ -zearalenol or both  $\alpha$ - and  $\beta$ -zearalenol were found.

High intraspecies diversity within *R. erythropolis*

	Degradation	Detoxification
<i>R. erythropolis</i> LMG 16262	100%	98%
<i>R. erythropolis</i> BD2	92%	-16%
<i>R. erythropolis</i> SQ1	85%	5%
<i>R. erythropolis</i> LMG 16260	63%	13%
<i>R. erythropolis</i> LMG 4059	25%	11%
<i>R. erythropolis</i> R42661	0%	0%

**Results for six different *R. erythropolis* strains.** Both high degradation combined with lowered and increased toxicity were observed, as well as limited to absent degradation.

## Take home messages

- Degradation of ZEN by Actinobacteria does not necessarily go hand in hand with detoxification. Also an increase in estrogenic toxicity, or no change in toxicity, have been observed.
- This highlights the importance of toxicity testing during the screening phase.
- For *Rhodococcus* sp. a high intra- and inter-species diversity in the degradation and detoxification of zearalenone is observed.

