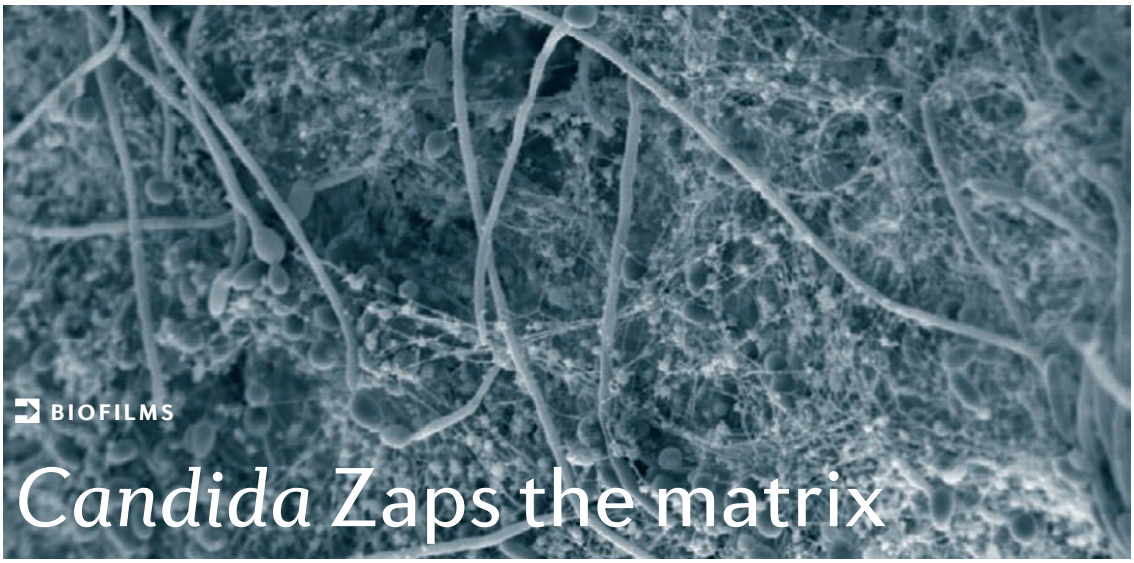

Scanning electron micrograph showing *in vivo* biofilm formation in a *Candida albicans zap1Δ/zap1Δ* mutant. Image courtesy of J. Nett and D. Andes, University of Wisconsin, USA.

BIOFILMS

Candida Zaps the matrix

Although the biochemical composition of the matrix of the biofilms that are formed by the opportunistic fungal pathogen *Candida albicans* is well understood, we know little about the regulation of matrix production. Results recently published in *PLoS Biology* by Clarissa Nobile and colleagues have now provided the first mechanistic insights into this crucial process.

Biofilms are dynamic, often structurally complex communities of surface-adhering microorganisms that are embedded within an extracellular polymeric matrix. Fungal biofilms cause a particular clinical problem, as they are a source of infections on indwelling medical devices such as catheters. In general, biofilm matrices, which provide crucial architectural support and protection for the microbial communities that they surround, are composed of extracellular polysaccharides. The production of the matrix is a key factor in biofilm growth and development, yet little is known about its regulation in *C. albicans*.

> “Zap1 was confirmed to be a negative regulator of matrix production in an *in vivo* model of biofilm formation.”

In the course of screening a *C. albicans* gene insertion library for defects in biofilm formation, Nobile *et al.* noticed that the biofilms formed by mutants with an insertion in the gene encoding the zinc-responsive transcription factor Zap1 had an unusual, glistening appearance. A more detailed look at biofilms lacking Zap1 (*zap1Δ/zap1Δ*) revealed an accumulation of soluble β-1,3 glucan, the main constituent of the *C. albicans* biofilm matrix. Zap1 was confirmed to be a negative regulator of matrix production in an *in vivo* model of biofilm formation.

The finer connections between Zap1 and matrix production were then probed using expression microarrays and genome-wide chromatin immunoprecipitation analysis of biofilm cells to identify Zap1 target genes. The expression of genes from many different classes was shown to be affected, either positively or negatively, by deletion of Zap1, and the authors homed in on a few selected putative activators and inhibitors of matrix production. Using promoter fusions and the rat catheter infection model to assess gene function in biofilms *in vivo*, two matrix inhibitors, the alcohol dehydrogenases Csh1 and Ifd6, and three matrix activators, the glucoamylases Gca1 and Gca2 and another alcohol dehydrogenase, Adh5, were confirmed as members of the Zap1 regulon.

The authors went on to speculate about the specific roles of these proteins. The glucoamylases Gca1 and Gca2 are likely to promote matrix production directly, by stimulating the hydrolysis of insoluble β-1,3 glucan. In fungi, acyl and aryl alcohols are known to function as quorum sensing signals, and the authors finish by proposing that the alcohol dehydrogenases Csh1, Ifd6 and Adh5 generate quorum sensing signals that influence the production of the biofilm matrix. Further work will be required to confirm this intriguing suggestion.

Sheilagh Molloy

ORIGINAL RESEARCH PAPER Nobile, C. J. *et al.* Biofilm matrix regulation by *Candida albicans* Zap1. *PLoS Biol.* **7**, e1000133 (2009)