



Small secreted polypeptides for treating fungal disease in plants

Current crop disease control is heavily reliant on the application of synthetic fungicides and bacteriocides. However pathogen resistance to chemical control has in some cases become widespread and thus the need for biocontrol methods in disease pathogenesis is a focus of intense research. The global Biological Control Market is stated to grow at a CAGR of 13.6% during 2016-2021 forecast period in order to reach a market value of \$3588.35 million by 2021.

Zymoseptoria tritici (*Z tritici*) is the causal agent of Septoria tritici Blotch (STB) and through its interaction with the wheat host plant during infection, it produces a series of small secreted proteins (ZtSSPs) termed effector proteins which are able to manipulate host physiology and interfere with plant immunity. Researchers at University College Dublin (UCD) have identified a number of these small secreted ZtSSP proteins and have demonstrated that transient overexpression of these proteins results in rapid accumulation of hydrogen peroxide (H_2O_2) and upregulation of defence-associated genes and cell death in the model plant *N benthamiana*. These findings suggest these proteins could be used as biocontrol agents by manipulating host immune response in treating and preventing microbial infections in plants.

Technology Description

Plants are under constant exposure to pathogens such as fungi, bacteria, viruses and nematodes. Whilst plants have evolved to develop initial barrier defence mechanisms and innate immune systems to counteract infection, successful pathogens are able to counteract this immunity by producing effector proteins to manipulate host physiology and interfere with plant immunity. However ongoing research has revealed that these effector proteins may have other functions as well, such as roles in pathogen self defence. The characterisation of microbiota-manipulating effectors can contribute to more targeted biocontrol strategies.

Researchers at UCD have identified a number of effector proteins (ZtSSPs) secreted by the fungus *Z tritici* whose over-expression is found to induce varying levels of cell death within the *N benthamiana* plant. *N benthamiana* is a member of the Solanaceae family and is the most widely used experimental host in plant virology, due mainly to the large number of diverse plant viruses that can successfully infect it. Additionally, *N benthamiana* is susceptible to a wide variety

of other plant-pathogenic agents making this species a cornerstone of host-pathogen research, particularly in the context of innate immunity and defense signaling. Treatment with these 5 novel ZtSSPs leads to the induction of defense responses within the infected plant including hydrogen peroxide accumulation cell death and the upregulation of several defense marker genes. These candidates fail to induce cell death in wheat, the host plant for Septoria tritici infection, suggesting host specificity of ZtSSP functionality.

Further research on identifying host interacting partners is currently ongoing to determine the mechanism of action by which these ZtSSPs manipulate host immune response and whether this response is limited to specific plants/crops. It is postulated that other members of the Solanaceae family (such as the tomato, potato, pepper and eggplant) may also be susceptible to these proteins and thus these proteins may represent a novel biocontrol method for treating biotrophic pathogens that infect these plants.

VALUE PROPOSITION:

Small secreted polypeptides for use in treating or preventing microbial infections in plants.

KEY FEATURES AND BENEFITS:

- Differential defense gene expression patterns dependent on the ZtSSP used.
- Rapid induction of ROS (reactive oxygen species) cell death and expression of key defense markers in response to treatment with the identified ZtSSPs.

MARKET

Biotechnology companies, fungicide and pesticide industry sectors.

STATUS

UK patent application has been filed 14th September 2018 (patent application number 1814950).

OPPORTUNITY

Licensing Opportunity.



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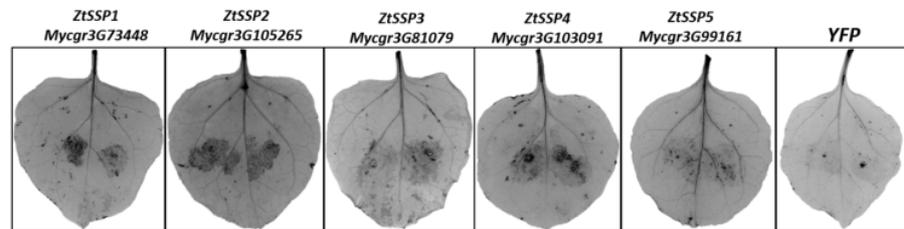
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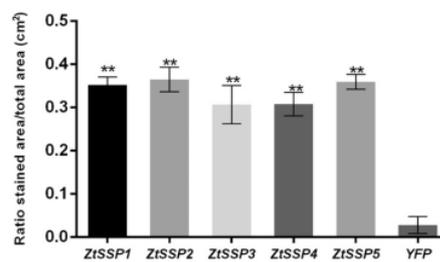
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A



B



Expression of ZTSSP's resulted in accumulation of hydrogen peroxide in *N. benthamiana*:

Rapid accumulation of hydrogen peroxide (oxidative burst) is a well-known phenomenon in a non-host resistance response. To examine whether chlorosis and cell death phenotype obtained by ZtSSP candidates in *N. benthamiana* was due to accumulation of H₂O₂ leaves, the leaves expressing candidate proteins were stained for H₂O₂ at 2 days post inoculation (dpi). The expression of the candidates resulted in rapid accumulation of H₂O₂. The relative staining was significantly higher in all the ZtSSP infiltrated leaves compared to YFP-control leaves.

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