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Novel genes which enhance plant resistance and immunity to economically devastating diseases

VALUE PROPOSITION:

Integration of novel genes through genetic engineering technology to produce FHB resistant cultivars . FHB resistance genes that can be used as selective markers in crop breeding programmes.

KEY FEATURES AND BENEFITS:

- Overexpression of identified genes and the DON responsive promoter leads to a reduction in DON-bleached spikelets in grain.
- Expression of these novel genes limits the spread of FHB disease within crops through the generation of disease resistant transgenic strains.
- Enables selective breeding of crop strains which naturally express the identified genes

MARKET

Agricultural Biotechnology companies, Agrochemical companies, Crop Protection and Seed companies.

OPPORTUNITY

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Fusarium Head Blight (FHB) is a devastating fungal disease in plants, in particular in cereals such as wheat, barley and oats. FHB has major implications for wheat and barley supply chains in countries such as the United States and Canada raising costs and risks for growers, inducing them to use more costly management practices and/or shifting to other crops.
In wheat, the fungus infects the head of the plant by entering through the flowers and causes the kernels to shrivel up. It also produces a mycotoxin called deoxynivalenol (DON). Globally, mycotoxins have a significant impact on human and animal health, economies and international trade impacting on food security. Mycotoxin contamination of feed is an area of great concern because of the negative health effects on animals. Furthermore, feed contamination can also represent a hazard for the safety of food of animal origin and contributes to mycotoxin intake in humans.

The use of host resistance is considered to be an efficacious means to control FHB. The research team at UCD along with collaborators in Teagasc, have identified a number of genes whose expression within cereals contributes to resistance to FHB. This exciting technology enables the biotechnology industry to identify and selectively breed existing disease-resistant cereal strains. Importantly integration of these novel genes through genetic engineering into susceptible crops enables disease resistant species to be generated.

Technology Description

The identification of novel genes that enhance plant resistance and immunity to disease is a major objective of crop research globally. Researchers within UCD and Teagasc have identified a number of genes (referred to as ENST-1, TaLRR-6D and TaNAC5D) which are capable of enhancing disease resistance to FHB. These genes may be introduced into plant host cells to express the recombinant proteins to impart or enhance FHB resistance in the plant. The identified genes may also be used to provide a functional marker for FHB resistance by identifying FHB resistant cultivars using marker assisted selection and breeding processes.

ENST-1 is a DON-responsive orphan gene capable of enhancing salicylic acid induced cell death Salicylic acid signalling represents a key defense mechanism of the plant to prevent the spread of biotrophic and hemibiotrophic pathogens such as those causing the economically devastating fungal disease FHB. Pathogen invasion induces localized production of salicylic acid within the plant and the consequent localized cell death prevents the spread of disease. The team have also successfully identified a DON-responsive promoter to drive the expression of the ENST-1 gene and thus convey resistance to FHB.

TaLRR-6D is a gene that encodes a transmembrane leucine rich receptor kinase which regulate defense-related processes in plants .

TaNAC5D is a transcription factor and which stimulates stress regulators within plants such as the ENST-1 protein. Upregulation of ENST-1 activates the salicylic acid defense mechanism in response to FHB in wheat.

The risk of resistance breakdown is greatly reduced as these genes are native genes within wheat cultivars.

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STATUS

ENST-1[1]:PCT patent application filed 15th July 2015. (WO2016/008942). Patent has entered the National Phase in the following territories: US, BR, CA, CN.

TaLrr-6D[2]: PCT patent application filed 9th March 2018 (International Publication number WO2018/162750)

TaNAC-5D:[3] PCT patent application filed 135h October 2018 (PCT application number PCT/EP2018/078101).

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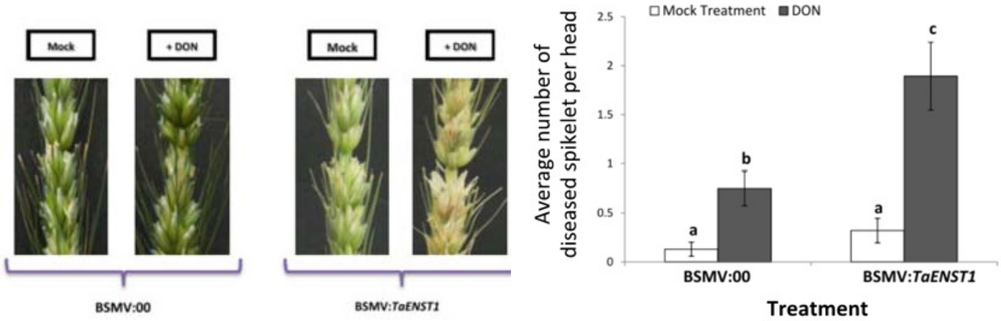
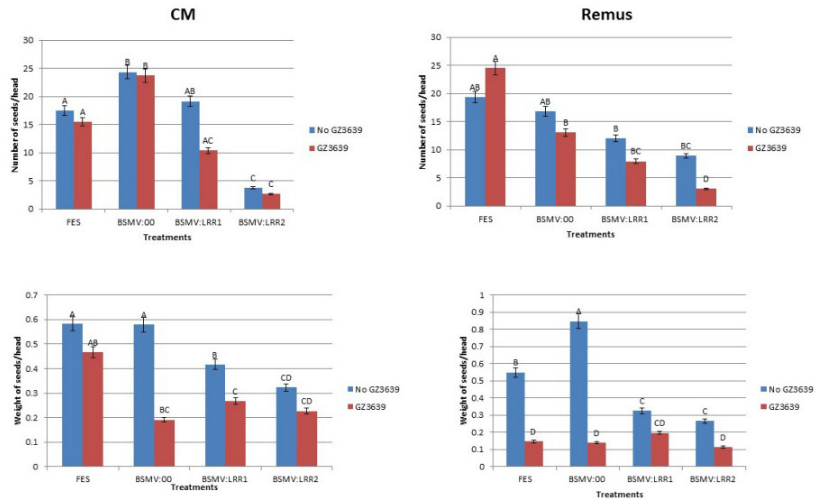


Silencing of the ENST-1 gene in wheat (as depicted by BSMV:TaENST1 above) and subsequent inoculation with the DON toxin (as depicted by BSMV:TaENST1 +DON above) resulted in a significantly increased number of DON bleached spikelets compared to the non-silenced control plants (as depicted by BSMV:TaENST1 Mock above). Plants expressing the ENST-1 gene that were not silenced were also included as controls (BSMV:00).



Silencing of the TaLrr-6D gene ((as depicted by BSMV:LRR1 and BSMZ:LRR2) in wheat resistant (CM) and susceptible (Remus) wheat cultivars resulted in a significant reduction in crop yield in FHB treated plants (GZ3639)versus Tween treated (control) plants (depicted as "no GZ3639" above) .

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