SELF FUNDED PHD OPPORTUNITY

Controlling cucumber powdery mildew disease using smart biologics and genome editing

Title: Controlling cucumber powdery mildew disease using smart biologics and genome editing

Supervisors: Professor Mahmut Tör (University of Worcester)
Professor Eric Holub (Warwick University)
Dr Tim Pettitt (University of Worcester)

Background

Microbial pathogens including fungi, oomycetes, bacteria, virus and nematodes are the causal agents of many important plant diseases [1]. They affect crops that are staple foods for humans and livestock and are responsible for significant economic losses every year. This in turn generates a global social impact [2]. In addition, climate change placing an impact on the reliability of food supply through emergence of new diseases or re-emergence of existing ones [3]. On the other hand, human activity is intensifying microbial disease dispersal by trade and transport beyond their original and natural range, and modifying natural environments and thus creating new opportunities for evolution of these pathogens allowing the occurrence of new isolates. In many cases, pesticides are the major form of control for fungal, oomycete, bacterial and nematode crop diseases [4]. Fungicides are used to either kill or prevent growth of the pathogen and its spores and can be very effective when applied correctly and at the appropriate time. Most fungicides are preventative rather than curative and are applied before symptoms appear. Some alternative control strategies of currently emerging plant diseases are based on the use of resistance inducers including vitamins, chitosans, oligogalacturonides, volatile organic compounds, azelaic and pipecolic acid [5]. Cucurbit crops suffers heavily from powdery mildews in temperate climates [6].

Summary and working hypothesis

ln our recent work, we found that a *Bacillus* strain induces resistance in *Arabidopsis* plants and prevents the infection of *Golovinomyces orontii*, the powdery mildew pathogen. This pathogen also causes serious disease on cucurbit crops in temperate areas. In addition, we have established CRISPR-based genome editing technologies in our laboratory and cucumber is amenable to genome editing techniques.
We hypothesize that when sprayed Bacillus or its broth can activate immune response and can be used in defence priming in crop plants. We also hypothesize that CRISPR-based genome editing can be used in mutating susceptibility genes in plants to create resistant lines.

Brief research programme and methodology

1) Determine the requirements for Bacillus induced defence in cucumber*:* We want to determine whether the application of Bacillus or its broth on cucumber will result in defence similar to that found in our work on Arabidopsis.
2) Investigate gene expression in powdery mildew infected cucumber plants using RNA-seq and identify susceptibility genes.
3) Use CRISPR system to generate mutant cucumber lines
4) Test mutant cucumber lines with the pathogen.

Student will have research training in: Molecular biology, plant pathology, gene cloning and plant transformation techniques and transcriptomics. Student will have opportunity to work with different groups and laboratories. Supervisors have extensive experience in supervising students, and collaborated and published joint papers before. Results obtained from this work will be published in internationally well-known journals and will be presented at international scientific meetings.

References:

1) Agrios GN (1997) Plant Pathology, 4th edn. New York: Academic Press. **2)** Daniel and Gurr (2015) Fungal Genetics and Biology 74, 62-64; **3)** Chakrabortya and Newton (2011) Plant Pathology 60, 2–14; **4)** Bush et al

(2006) Methods Mol. Biol. 323, 13-25; **5)** Aranega-Bou et al (2014) Front Plant Sci. 5: 488; **6)** Prondi et al. (2015) Plant Pathology. 65, 959-967