A protein that promotes crop immunity without compromising growth

Unmet Need
The human population is growing, and more food will be needed to sustain the global community, with an expected increase in total global food demand of 35% to 56% in the next 25 years. However, optimizing crop production is nontrivial and is becoming more difficult as climate change continues to increase both global temperature and the frequency of periods of elevated temperature (ET). ET renders plants more susceptible to pathogen infection, which ultimately sacrifices plant growth as part of a programmed growth-defense trade-off. Therefore, agriculture workers tend to use pesticides to suppress plant immunity and chemically ablate pathogens, thus allowing crops to focus on growth. Unfortunately, overuse of pesticides is common in agriculture and negatively impacts plant biodiversity, local ecology, soil microbes, and potentially the health of humans consuming these crops. While genetically encoded disease resistance is another method used to prevent infection, these genetic modifications are often less effective at ET. Thus, there is a need for new methods to preserve and improve plant immunity to pathogens.

Technology
Duke inventors have identified a protein that can ensure effective plant immunity not only at normal growth temperatures during but also during periods of ET, without compromising plant growth. This is intended to be administered to crops through modifying the promoter of a key immune regulator which is conserved in diverse plant species. Specifically, Duke inventors discovered that the recruitment of a transcription factor to target genes involved in the production of a major plant defense hormone, salicylic acid (SA), is specifically suppressed during ET. They further found that expression of this transcription factor gene is a rate-limiting step in SA production at ET. Finally, they showed that optimized expression of this gene broadly restored SA production, basal immunity and R gene-mediated immunity while maintaining appropriate growth qualities. Optimized expression, as opposed to constitutive and therefore growth-suppressing expression, was achieved using an inducible "uORF" system which only initiates in plants upon pathogen encounter. This has been demonstrated in Arabidopsis thaliana and is beginning to be demonstrated in a major oil crop Brassica napus. They also showed that temperature-sensitive pathogen defense was improved when exposed to pathogens which induce basal immunity or R gene-mediated immunity – immune reactions commonly provoked to guard crops against pathogens and insects. Further work is required to assess the effect of expression of the optimized target gene in other commonly grown crops and a wide range of pathogens.

Other Applications
This technology could also be used for protecting several other crops such as rice, rapeseed, tobacco, and numerous other crops which are known to utilize SA to fight infection. The identified target gene is also a master transcription factor which regulates a multitude of processes of plant immunity. Thus, this invention could be used to finetune specific immune processes to better equip crops with pathogen protection at both current and future (warm) climates.

Advantages
- First-in-class genetic approach to combat pathogens without compromising growth or temperature sensitivity
- Potentially applicable to many crops commonly affected by ET
- Broad effects of the CBP60g transcription factor to improve plant immunity
- Novel target for thermosensitive plant immunity
- Preserved plant immunity negates need for pesticides