



Histamine: a key compound in red light-enhanced *Fusarium verticillioides* resistance in maize

Xuanjun Feng^{1,2}, Dan Zheng², Weixiao Zhang², Huihui Xiao¹, Huarui Guan², Hao Xiong², Li Jia², Xuemei Zhang², Wenming Wang¹, Haiyang Wang³, Yanli Lu^{1,2}

¹State Key Laboratory of Crop Gene Exploration and Utilization in Southwest China, Wenjiang, China.

²Maize Research Institute, Sichuan Agricultural University, Wenjiang, China.

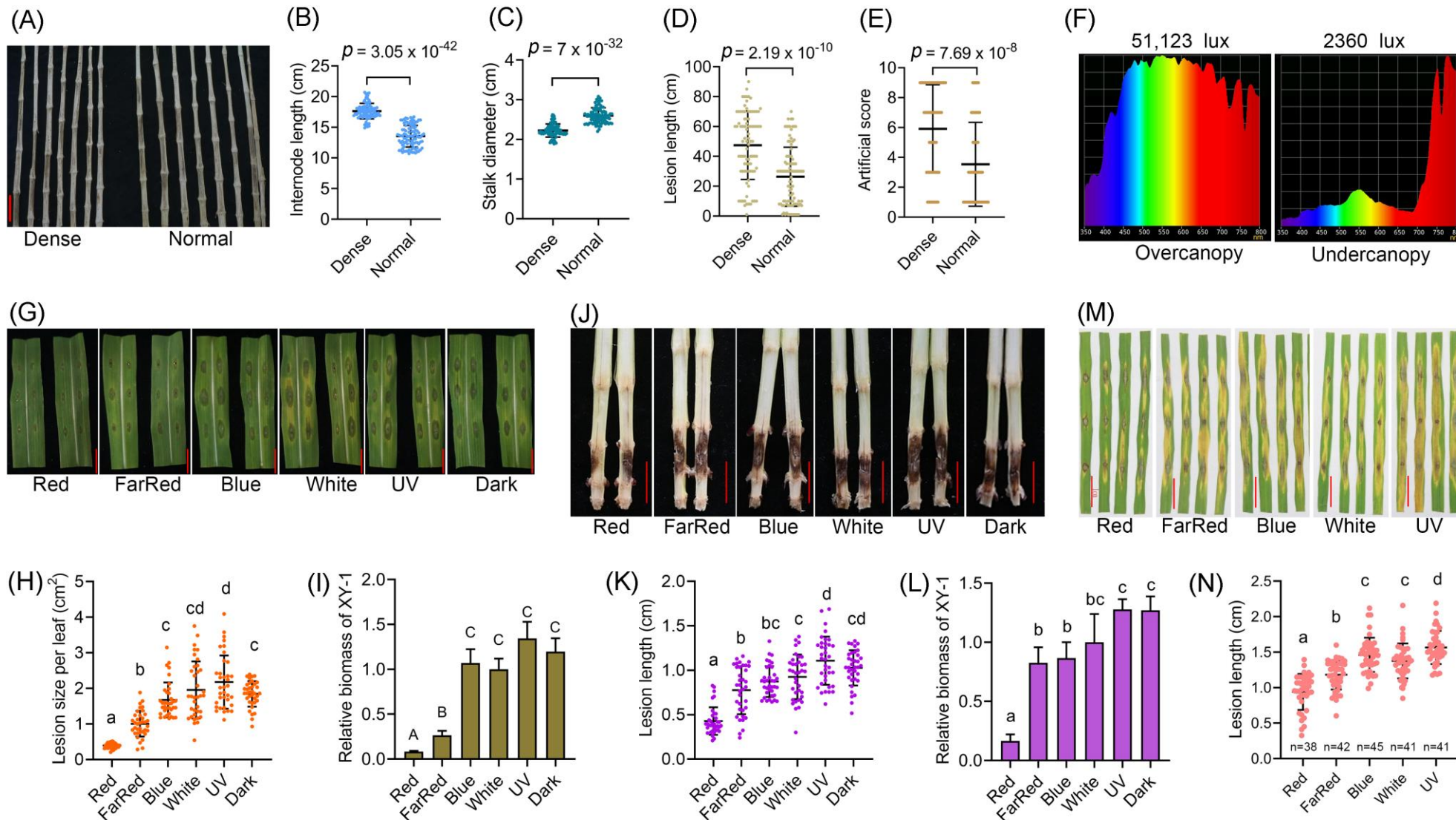
³State Key Laboratory for Conservation and Utilization of Subtropical Agro-Bioresources, South China Agricultural University, Guangzhou, China.



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Introduction

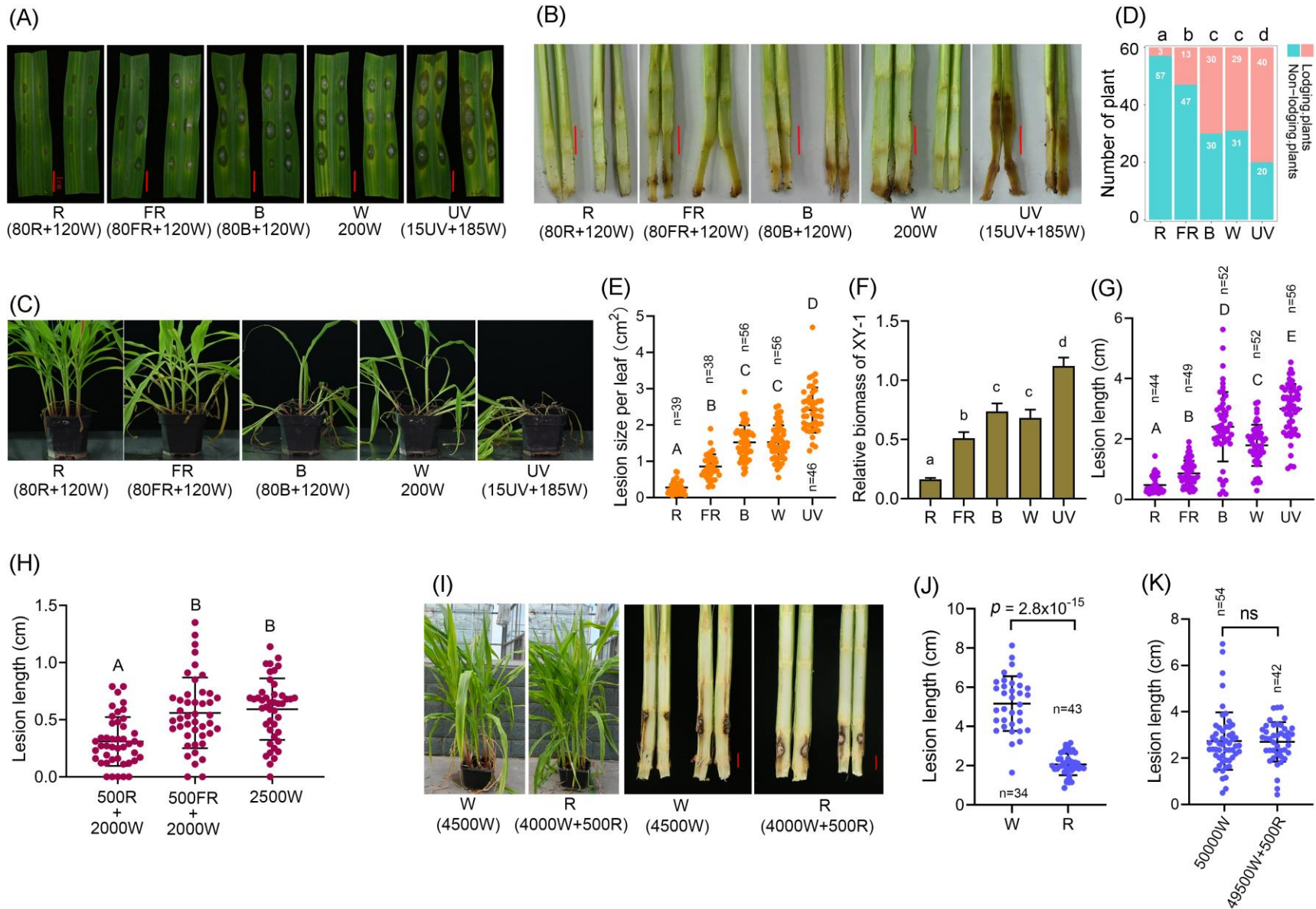


High-density condition promotes maize stalk rot caused by *Fusarium verticillioides*.

Red light, rather than far-red, blue, or UV light, significantly enhances maize resistance to *F. verticillioides*.



Introduction



Supplementation of red light effectively improves the resistance of maize to *F. verticillioides*.

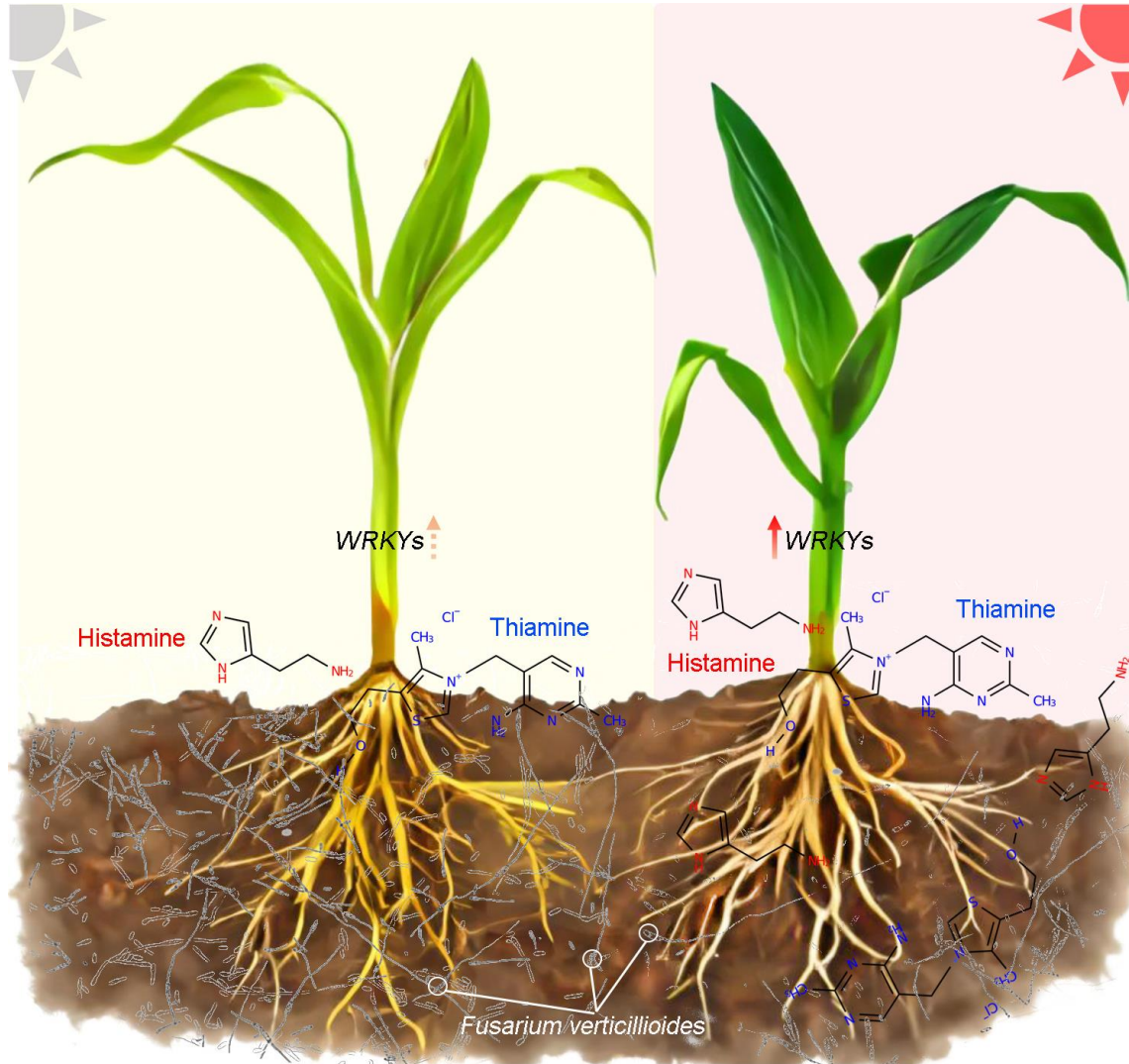


Questions

- ① whether the resistance of maize to *F. verticillioides* can be improved by manipulating crucial genes in the red light signaling cascade.
- ② the mechanism underlying the dependence of red light signal.

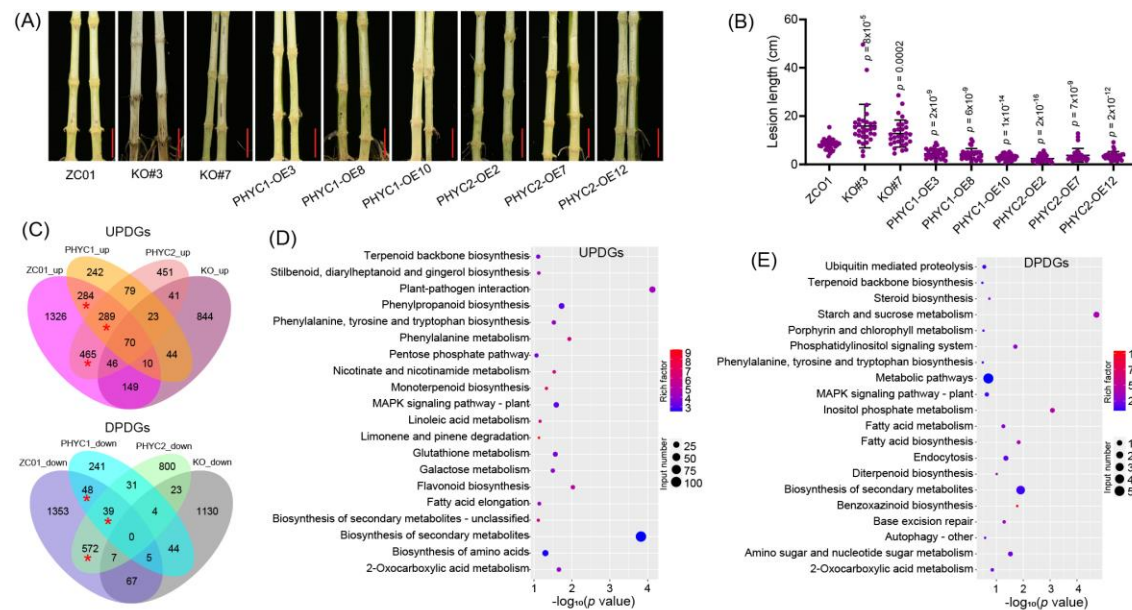
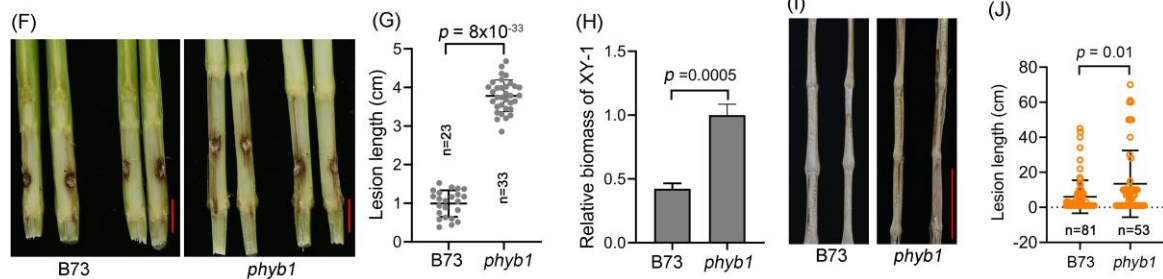
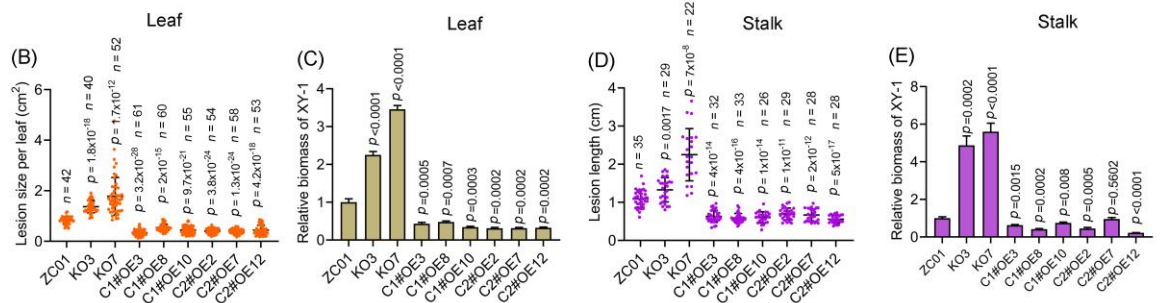
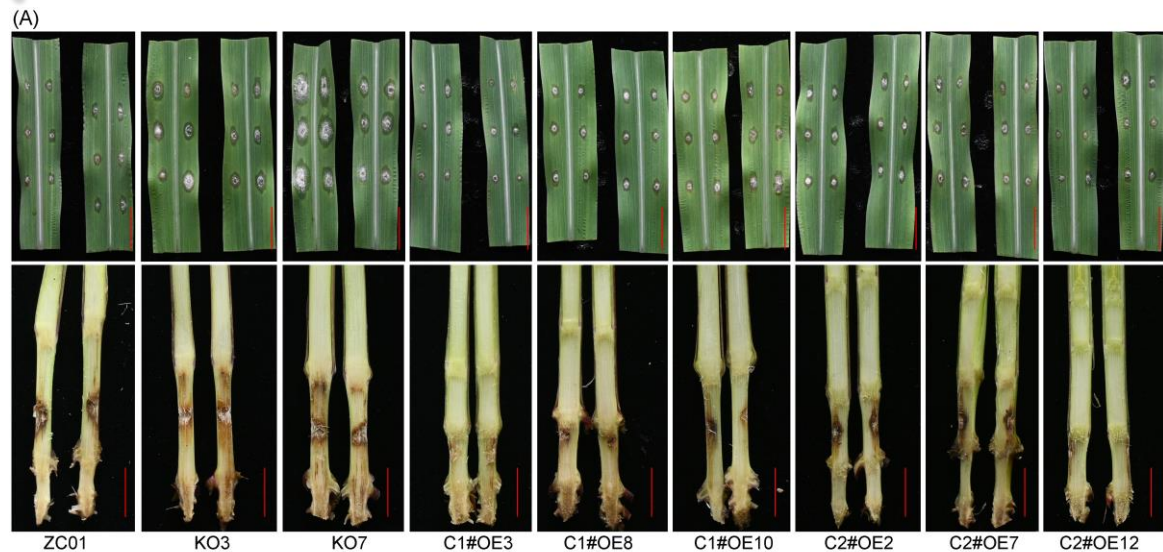


Highlights



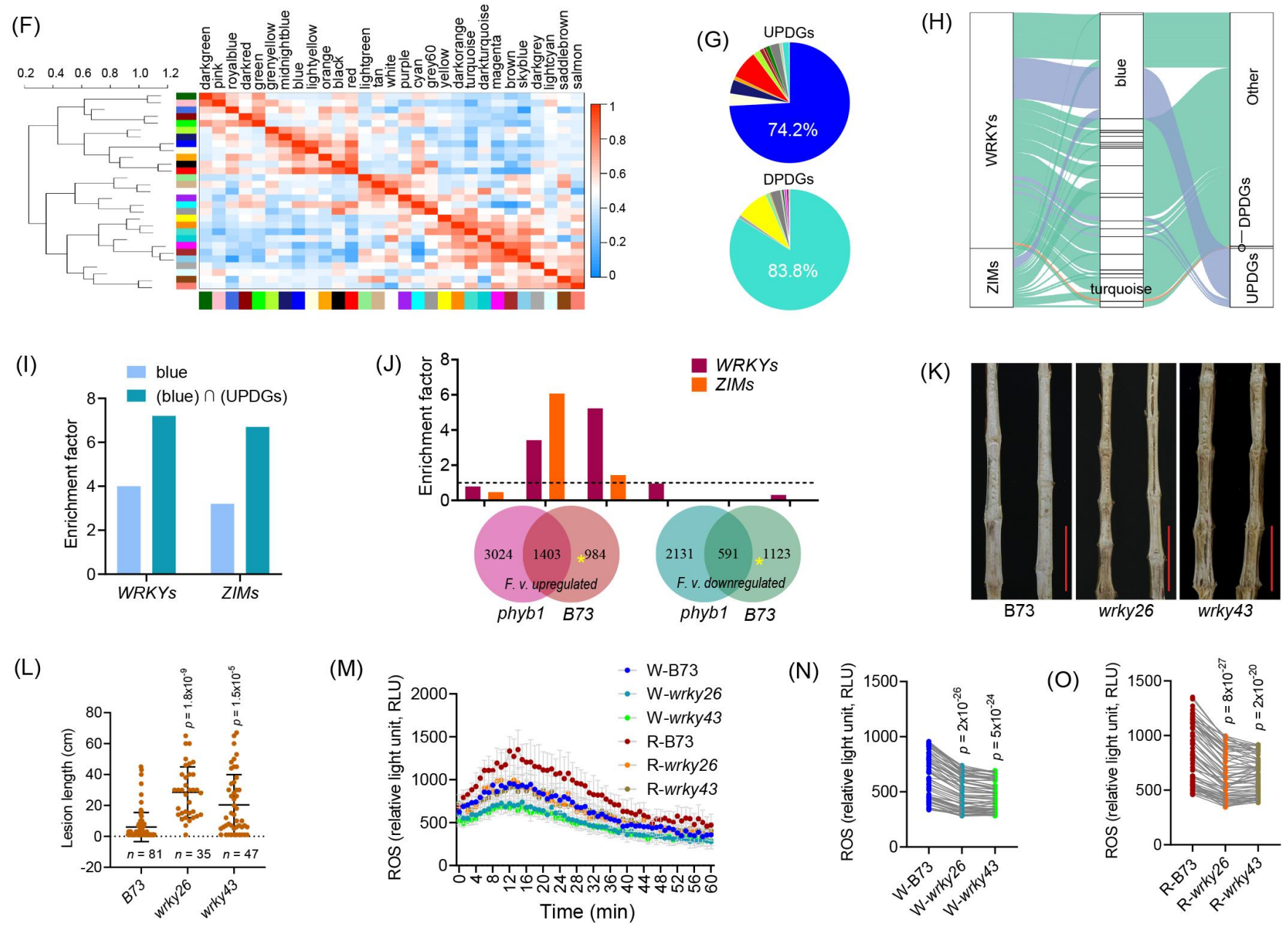
- Red light is the most effective wavelength for enhancing resistance to *Fusarium verticillioides* in maize.
- Enhancing red light signaling by manipulating red light receptors in maize significantly increases resistance to *F. verticillioides*.
- Two gene modules and several metabolites were identified as dependent on the red light receptor PHYC in the defense response against *F. verticillioides*, including key transcription factors such as WRKYs and important metabolites like histamine and thiamine.
- Histamine can enhance the resistance of maize against *F. verticillioides*.

Enhanced red light signal increases *F. verticillioides* resistance in maize

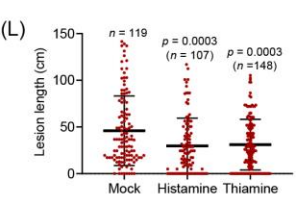
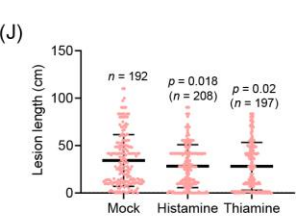
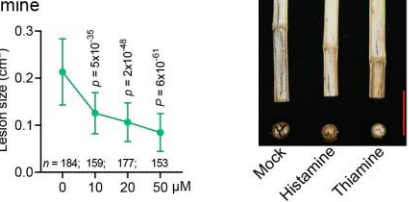
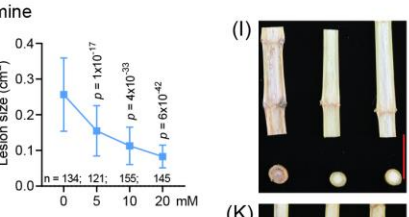
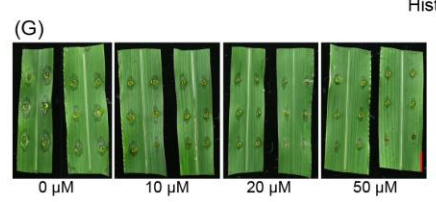
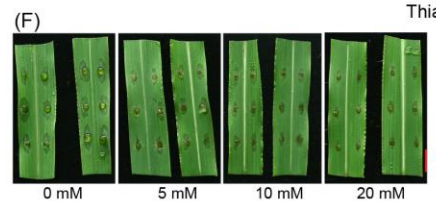
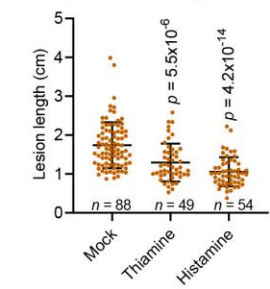
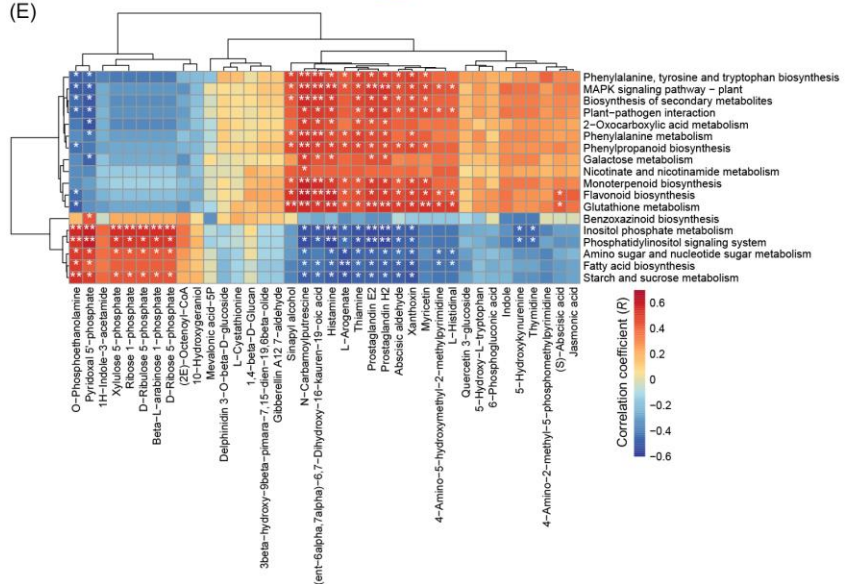
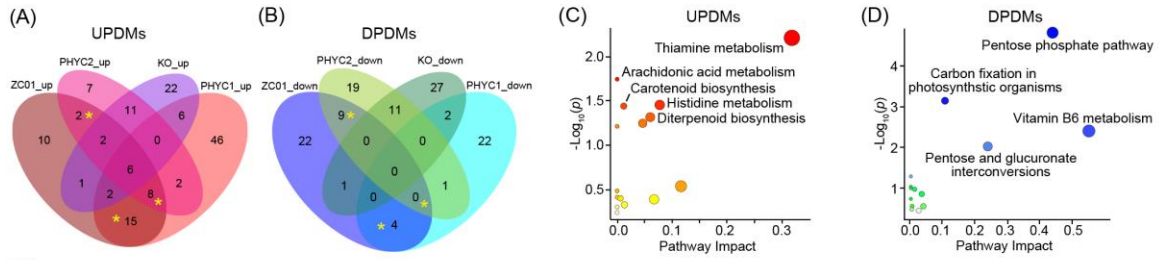


- The *Zmphyb1* and *Zmphyc1 Zmphyc2* double mutants displayed significantly greater susceptibility to *F. verticillioides* than the wild-type plants.
- Overexpression of *ZmPHYC1* or *ZmPHYC2* significantly increased resistance of maize to *F. verticillioides*.
- Majority of *F. verticillioides* invasion-responsive genes were PHYC-dependent.

WRKY transcription factors may be critical for PHYC/B-dependent defense responses



Thiamine and histamine are key metabolites that improve resistance to *F. verticillioides*



- *F. verticillioides* up-regulated PHYC-dependent metabolites were mainly enriched in thiamine metabolism, histidine metabolism, and diterpenoid biosynthesis.
- Thiamine and histamine enhanced the resistance to *F. verticillioides*, whereas O-phosphoethanolamine and phosphatidylinositol inhibited this response.
- The disease resistance conferred by thiamine and histamine was found to be more pronounced and stable under high-density planting conditions than under normal-density planting conditions.



Summary




- Enhancing red light signals may be an ideal strategy for sustainable agriculture, improving disease management and yield stability in high-density conditions.
- Histamine can enhance the resistance of maize against *F. verticillioides*, and it may have the potential to be developed into a new type of environmentally friendly chemical control agent for plant protection.

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