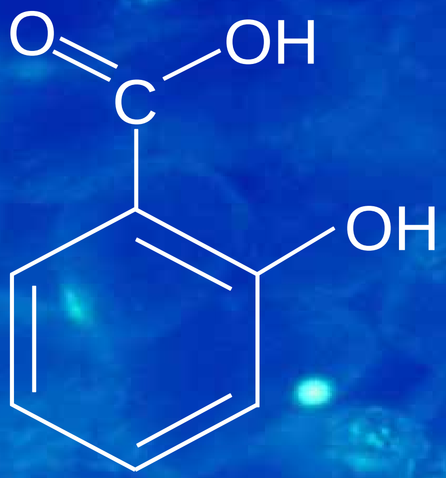
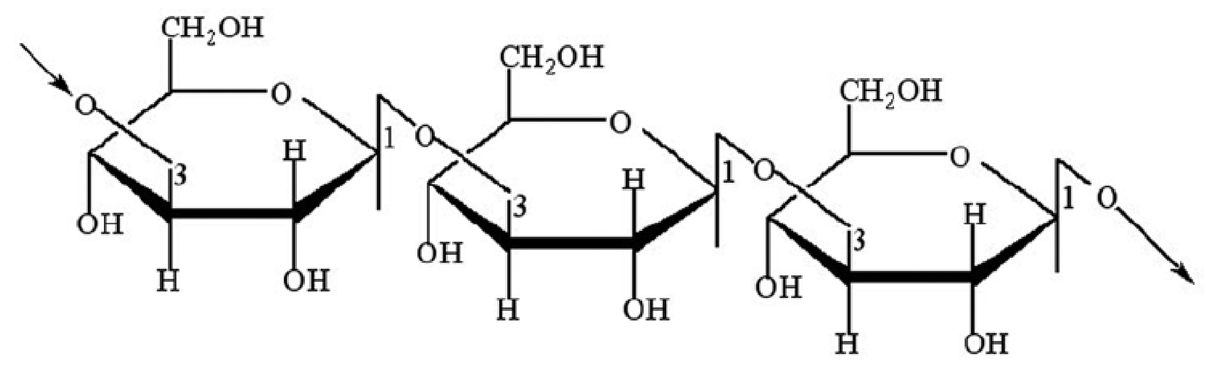
Targeting Pathogenicity Mechanisms to Promote FHB-Resistance in Wheat

Jyoti Shah
Jyoti.Shah@unt.edu
Dept. Biological Sciences
& BioDiscovery Institute
University of North Texas

Salicylic acid and callose contribute to host defense against *Fusarium graminearum*



Fusarium graminearum has evolved mechanisms to suppress host defenses



Callose: (1 à 3) b-D-glucan

SA degrading enzyme (FgNahG) is required for *Fusarium graminearum* virulence

toxins

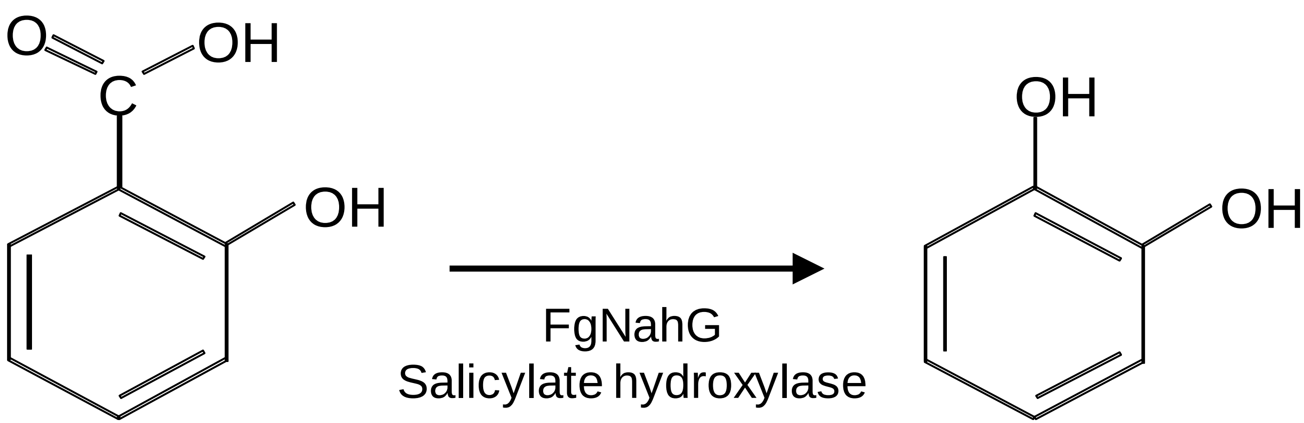
MDPI

Toxins **2019**, 11, 59; doi:10.3390/toxins11020059

Article

Functional Analysis of *FgNahG* Clarifies the Contribution of Salicylic Acid to Wheat (*Triticum aestivum*) Resistance against Fusarium Head Blight

Peng-Fei Qi [1,2,*,†], Ya-Zhou Zhang [2,†], Cai-Hong Liu [2], Qing Chen [2], Zhen-Ru Guo [2], Yan Wang [2], Bin-Jie Xu [2], Yun-Feng Jiang [2], Ting Zheng [2], Xi Gong [2], Cui-Hua Luo [2], Wang Wu [2], Li Kong [2], Mei Deng [2], Jian Ma [2], Xiu-Jin Lan [2], Qian-Tao Jiang [2], Yu-Ming Wei [2,*], Ji-Rui Wang [1,2] and You-Liang Zheng [2]

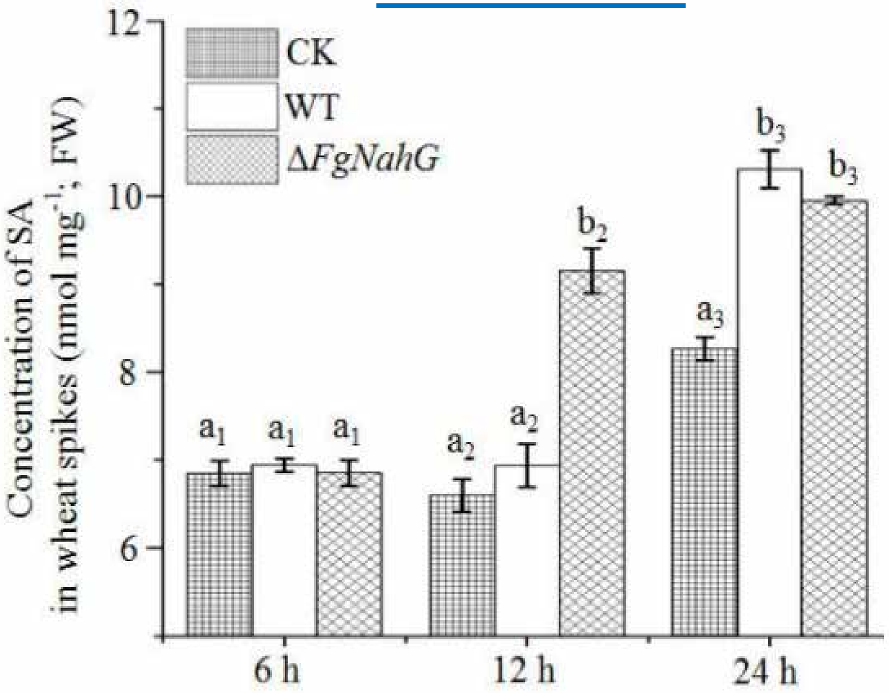


Salicylic acid

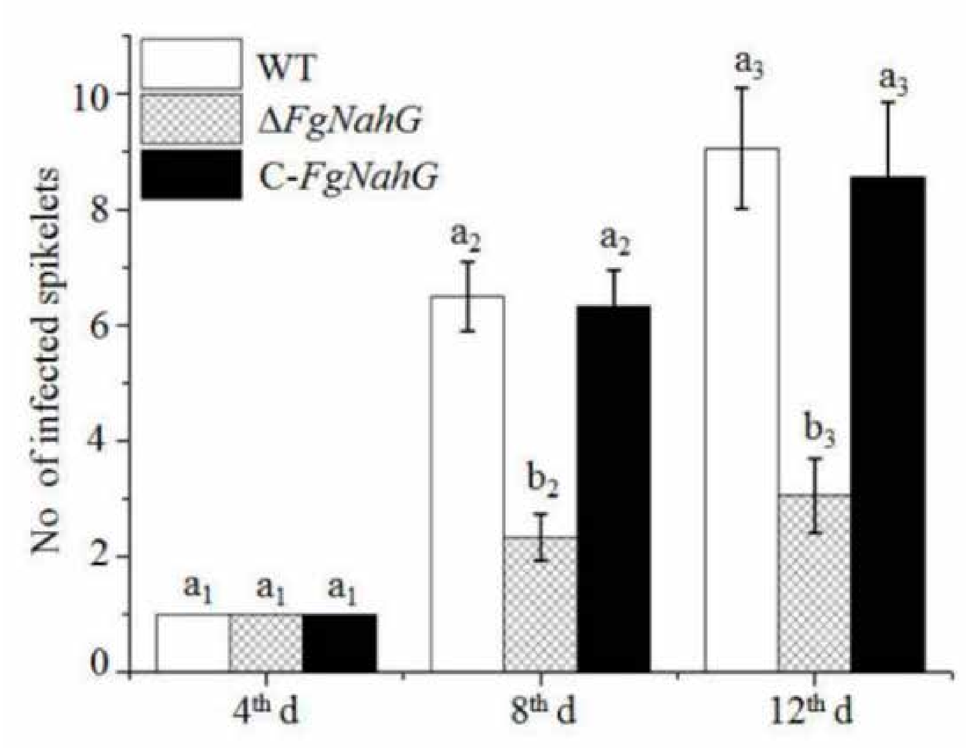
Catechol

FgNahG is required for *Fusarium graminearum* virulence on wheat

SA content



Disease severity



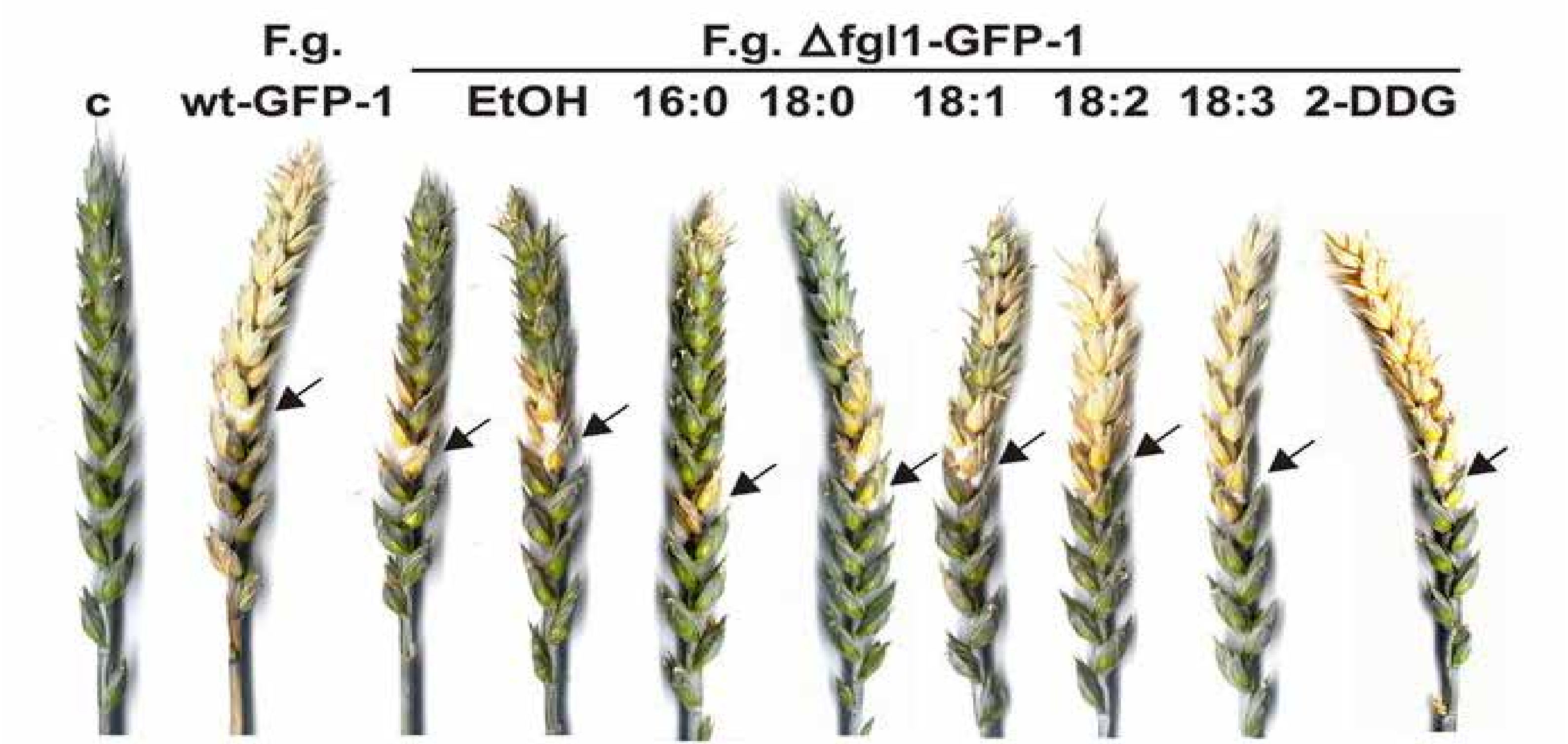
Qi et al. 2019 Toxins 11, 59;
doi:10.3390/toxins11020059

FGL1-encoded lipase is required for *Fusarium graminearum* virulence

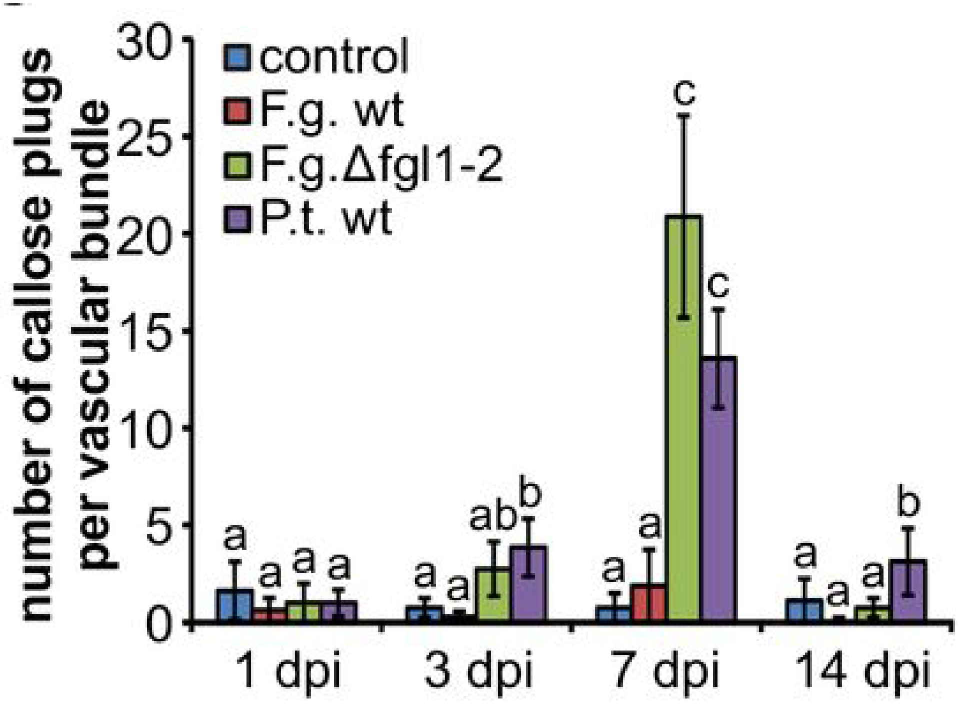
Secreted Fungal Effector Lipase Releases Free Fatty Acids to Inhibit Innate Immunity-Related Callose Formation during Wheat Head Infection[W][OPEN]

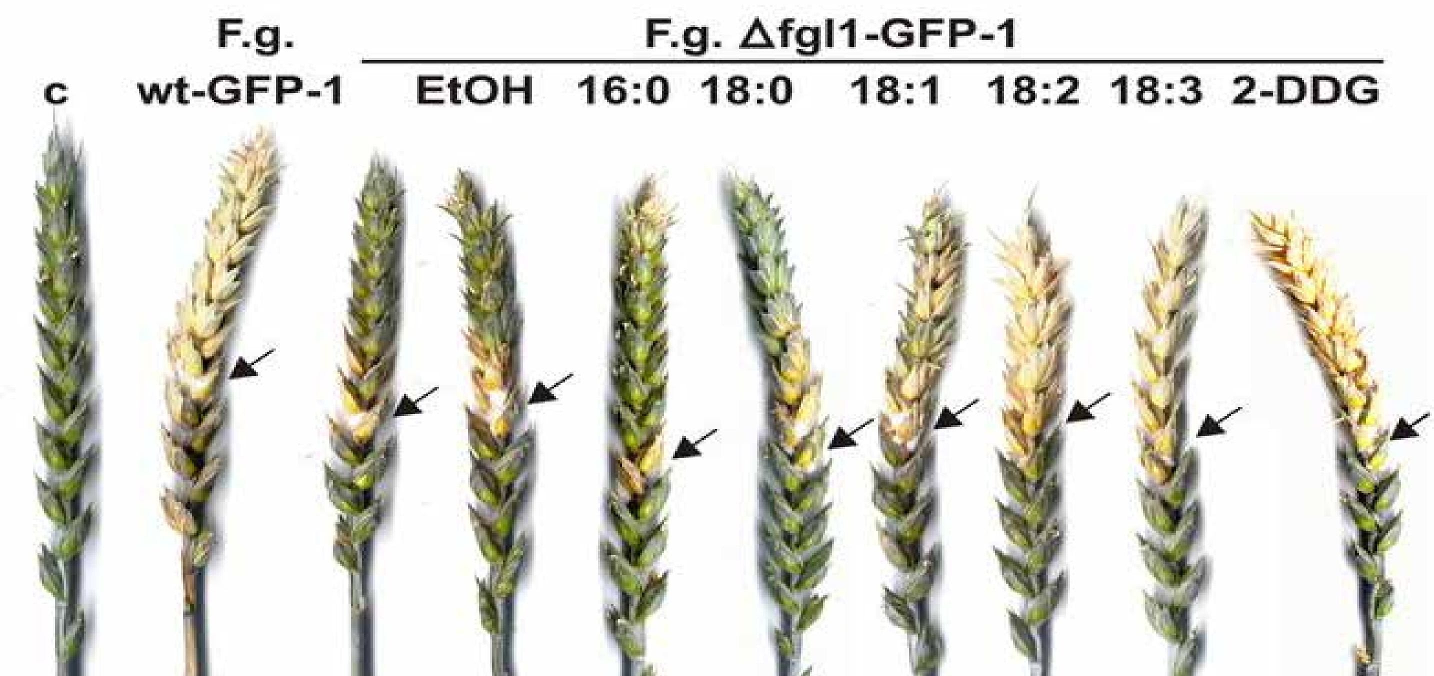
Plant Physiology, May 2014, Vol. 165, pp. 346–358

Antje Blümke[1], Christian Falter[1], Cornelia Herrfurth, Björn Sode, Rainer Bode, Wilhelm Schäfer, Ivo Feussner, and Christian A. Voigt*



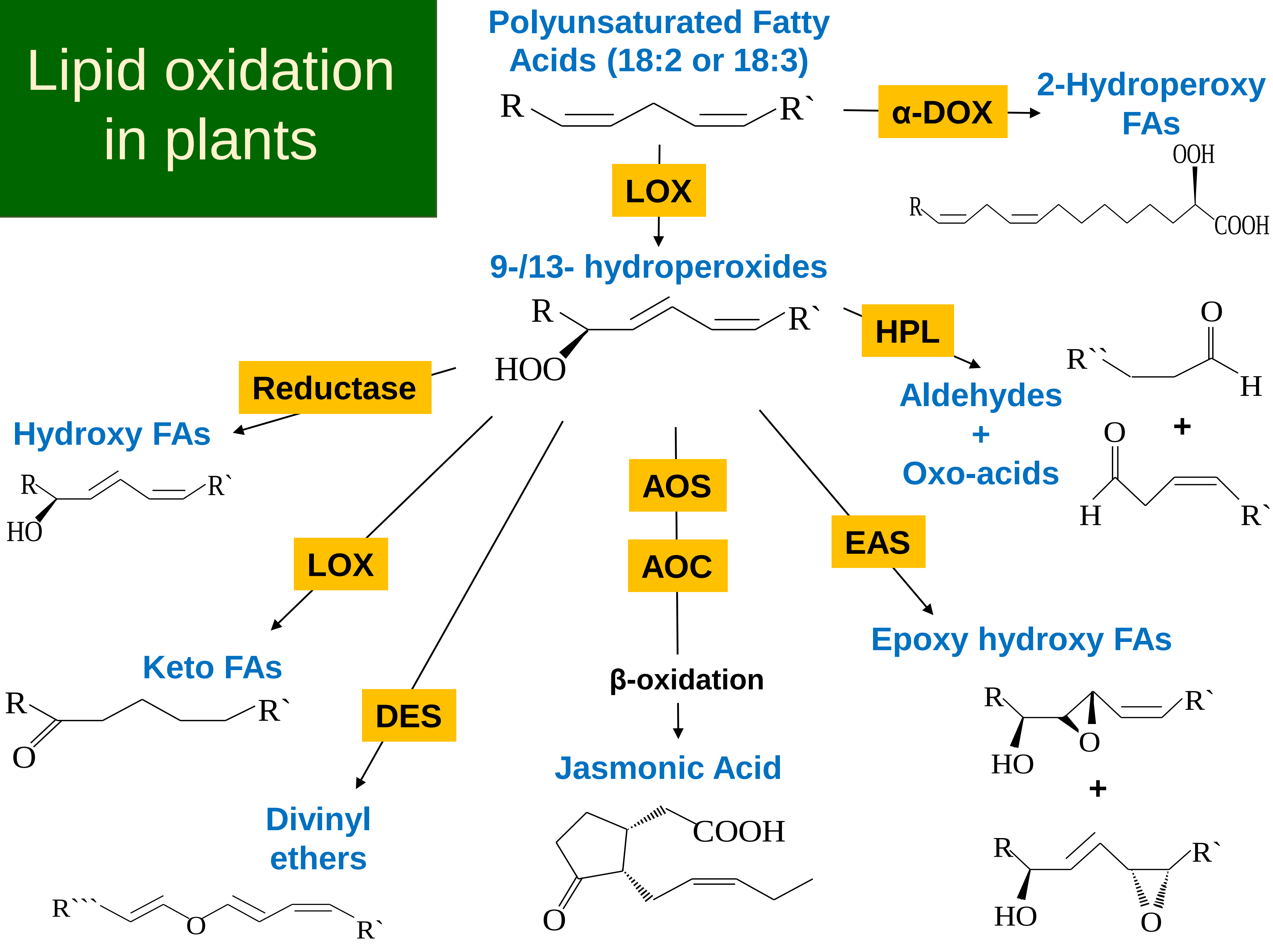
An FGL1-derived factor inhibits callose deposition to promote virulence



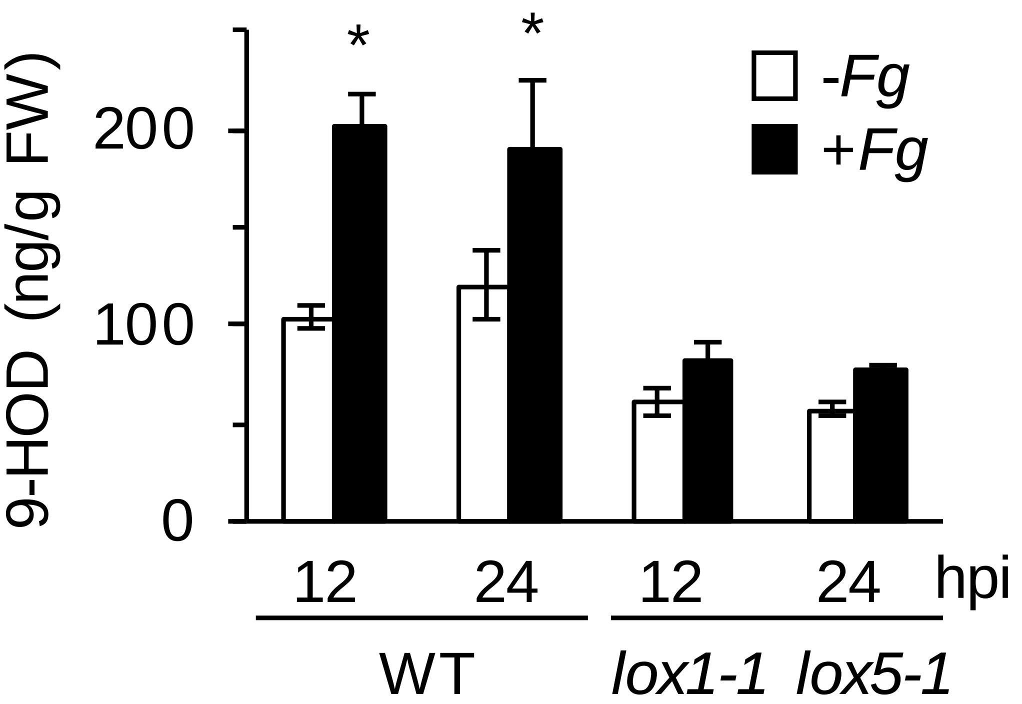


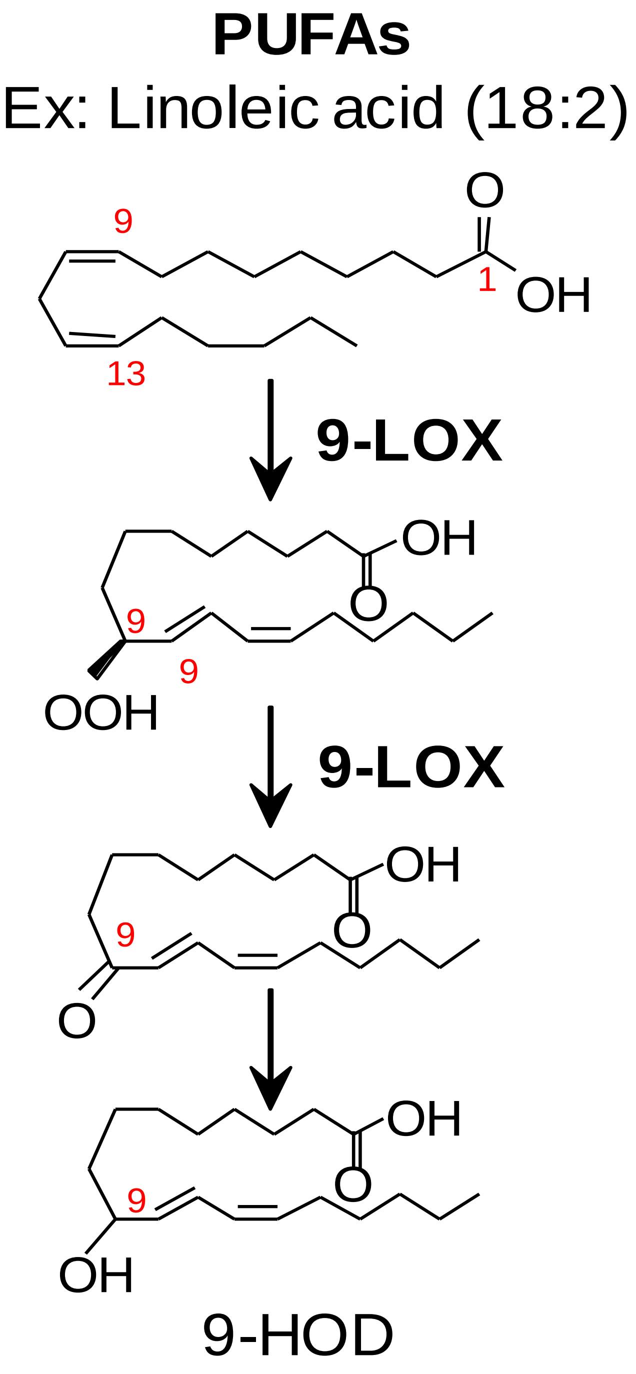
Blumke et al. 2014 Plant Physiology 165:346–358

Lipid oxidation in plants



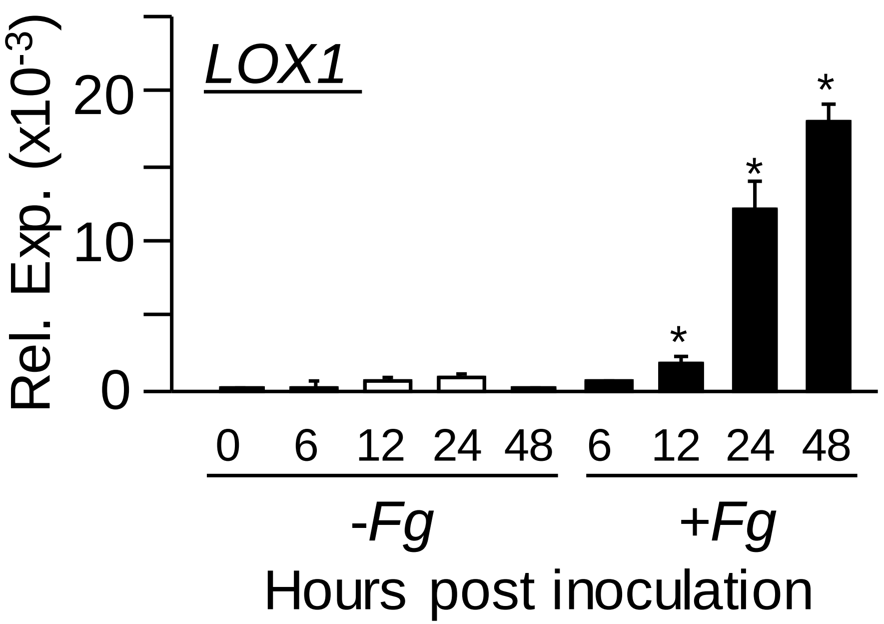
Fusarium graminearum infection promotes accumulation of 9-LOX-derived oxidized lipids

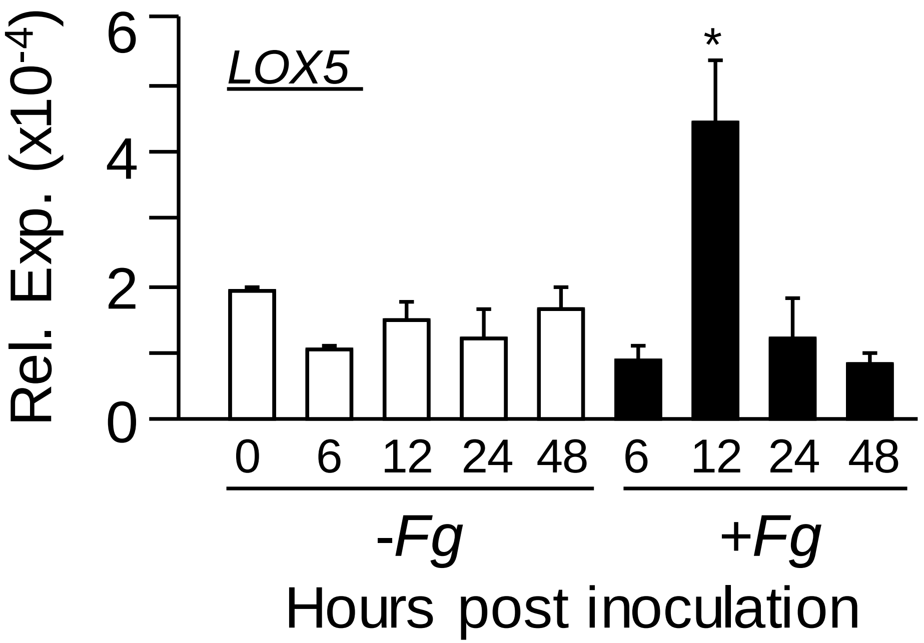




Nalam et al. 2015 Mol. Plant-Microbe Interact. 28:1142-1152

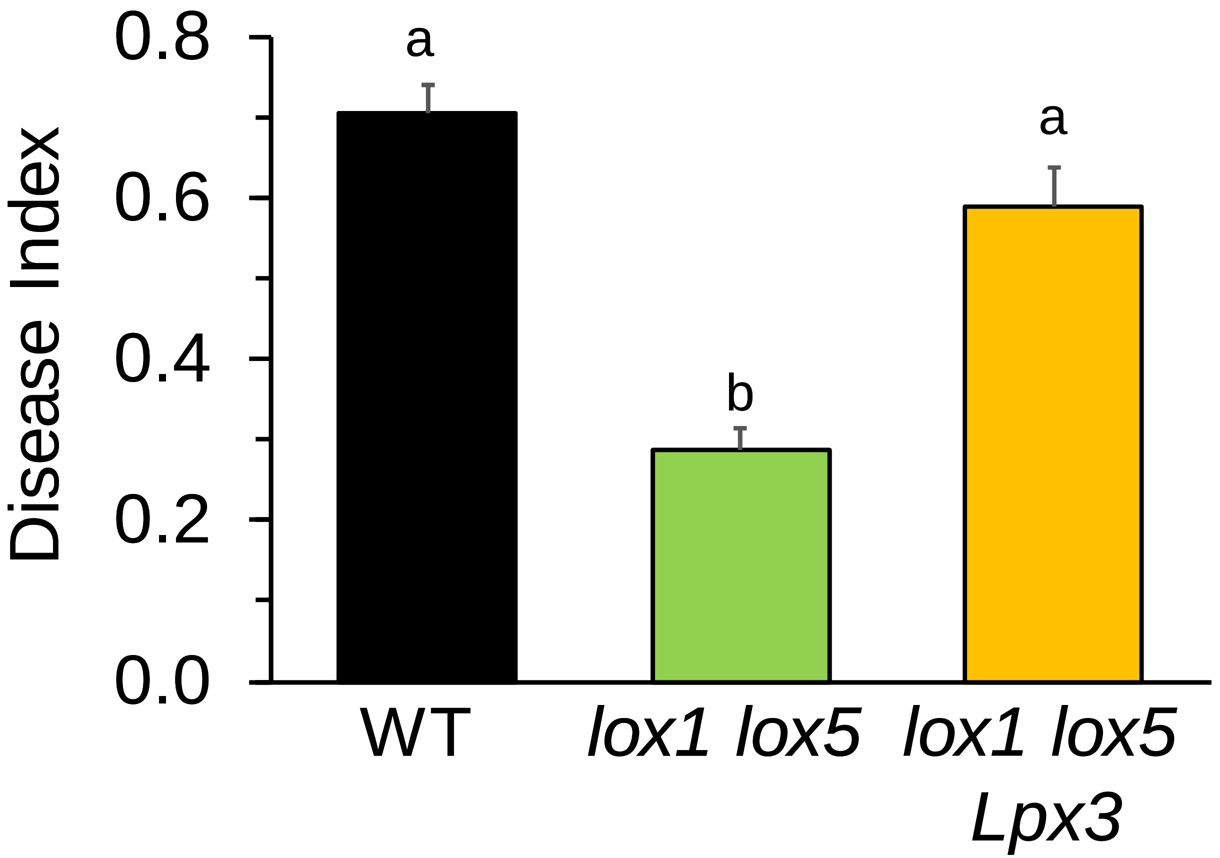
Fusarium graminearum infection stimulates expression of Arabidopsis 9-Lipoxygenase genes *LOX1* and *LOX5*





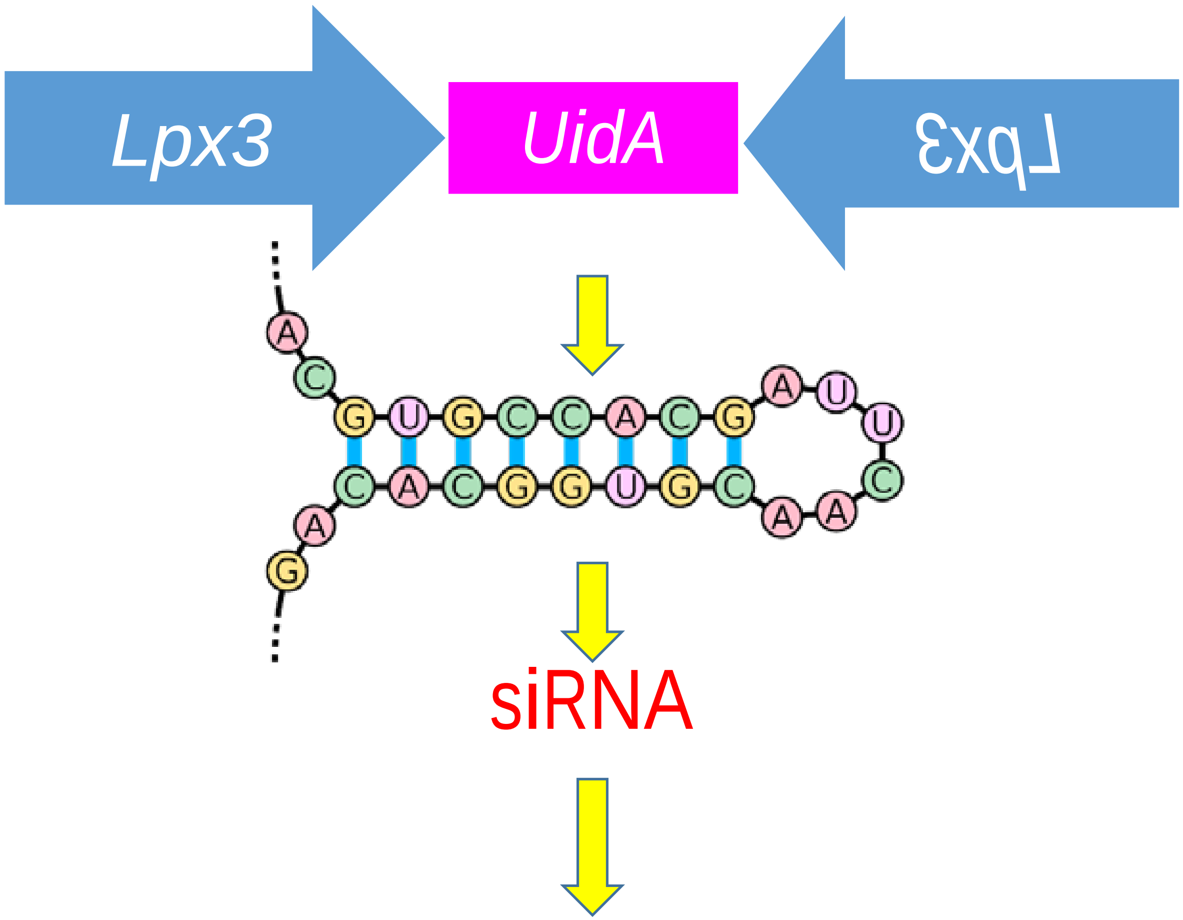
Nalam et al. 2015 Mol. Plant-Microbe Interact. 28:1142-1152

9-LOX deficiency in Arabidopsis confers resistance to *Fusarium graminearum*



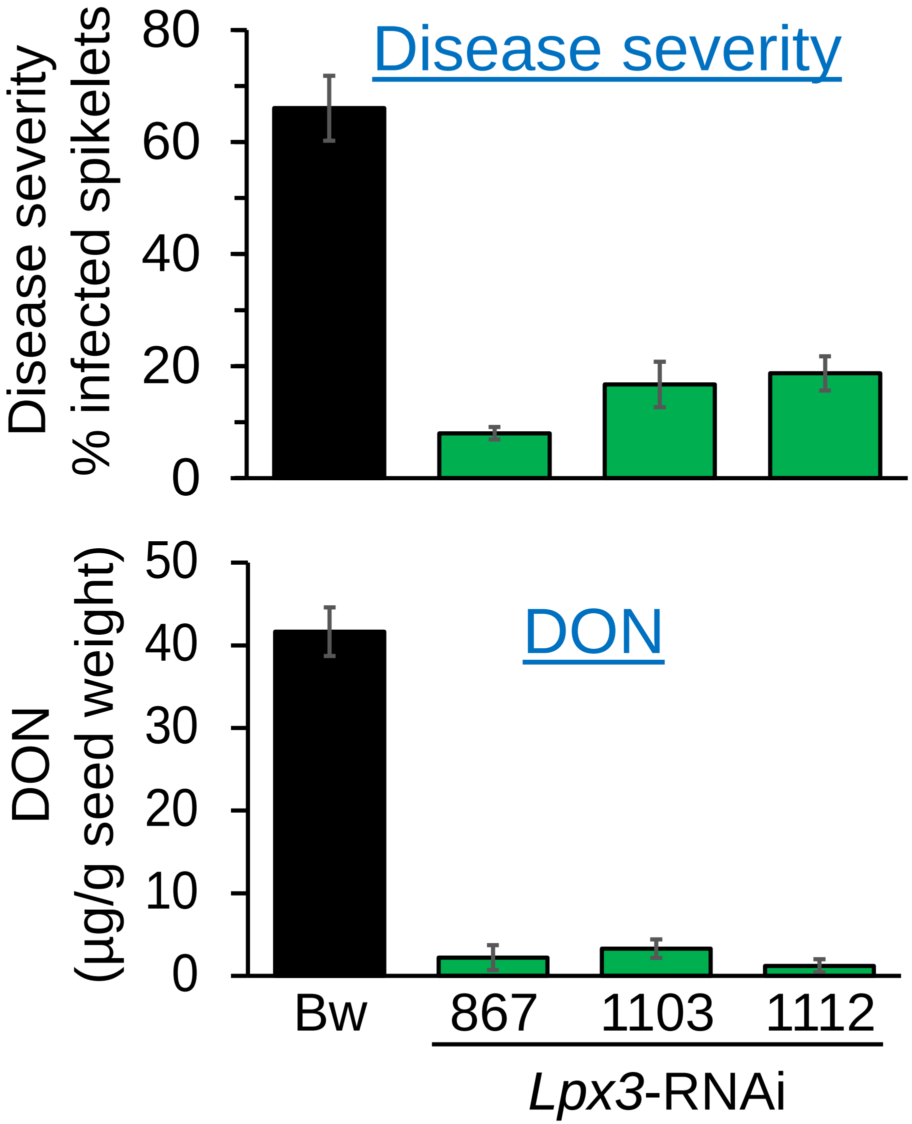
Wheat *Lpx3* complements 9-LOX deficiency in the Arabidopsis *lox1 lox5* double mutant

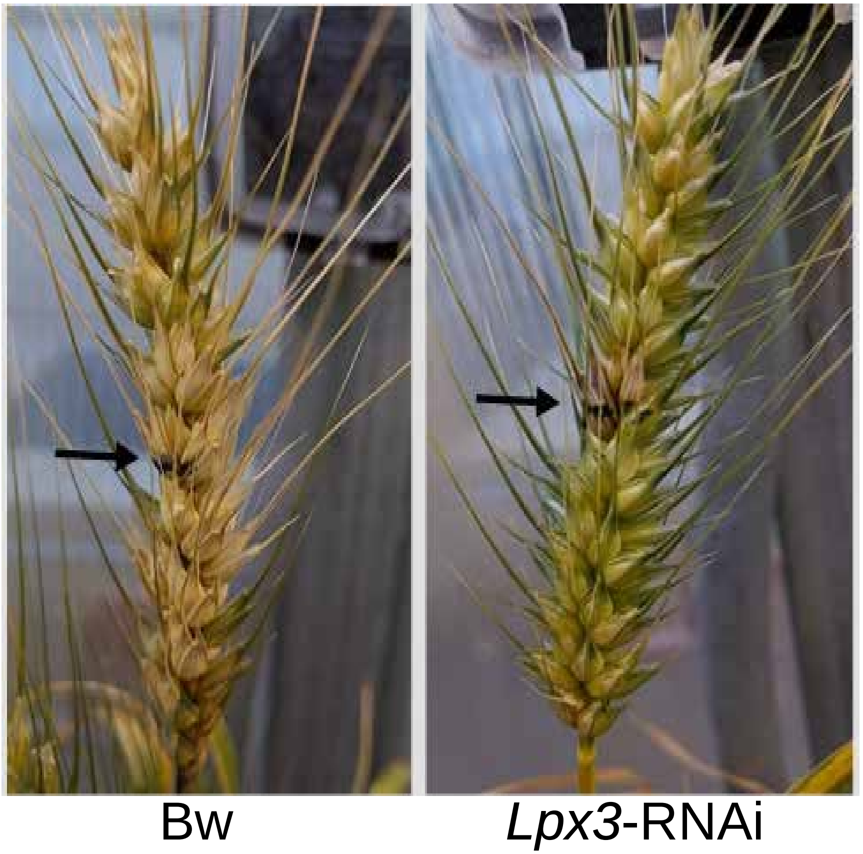
Does 9-LOX contribute to wheat susceptibility to *Fusarium graminearum*?



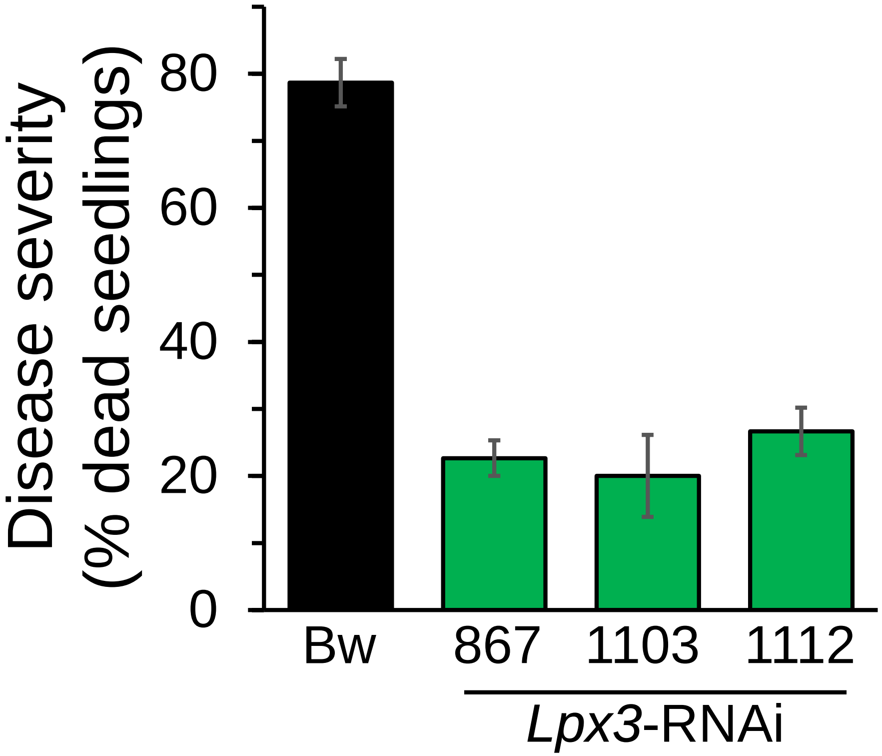
Knockdown *Lpx3* function

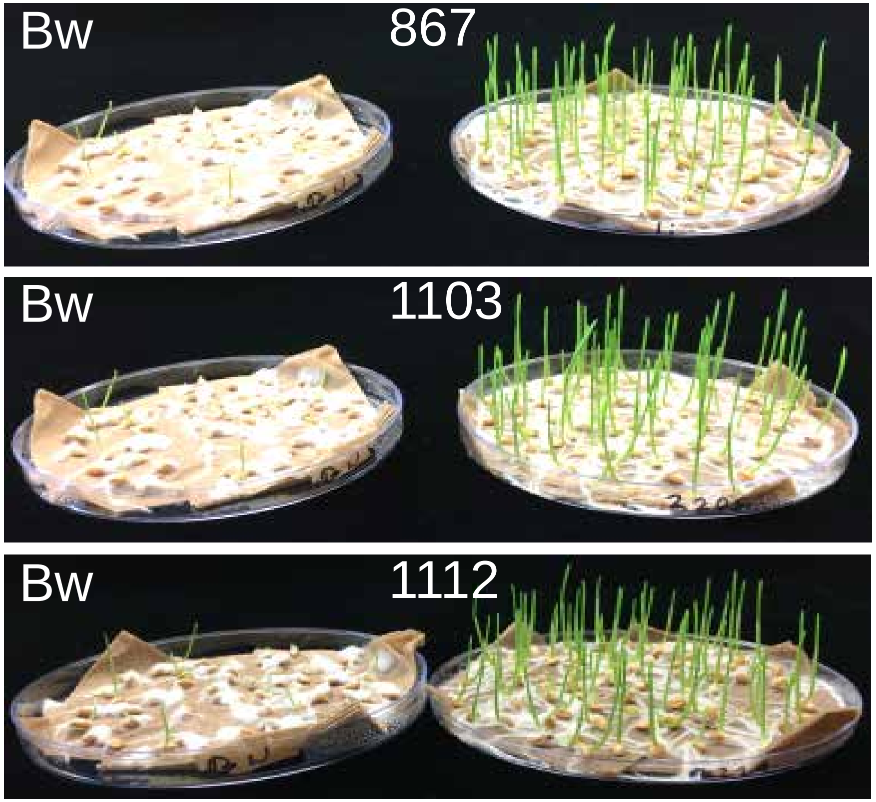
Lpx3-RNAi reduces FHB severity in the hexaploid wheat cv Bobwhite





Lpx3-RNAi reduces Fusarium seedling blight severity in the hexaploid wheat cv Bobwhite



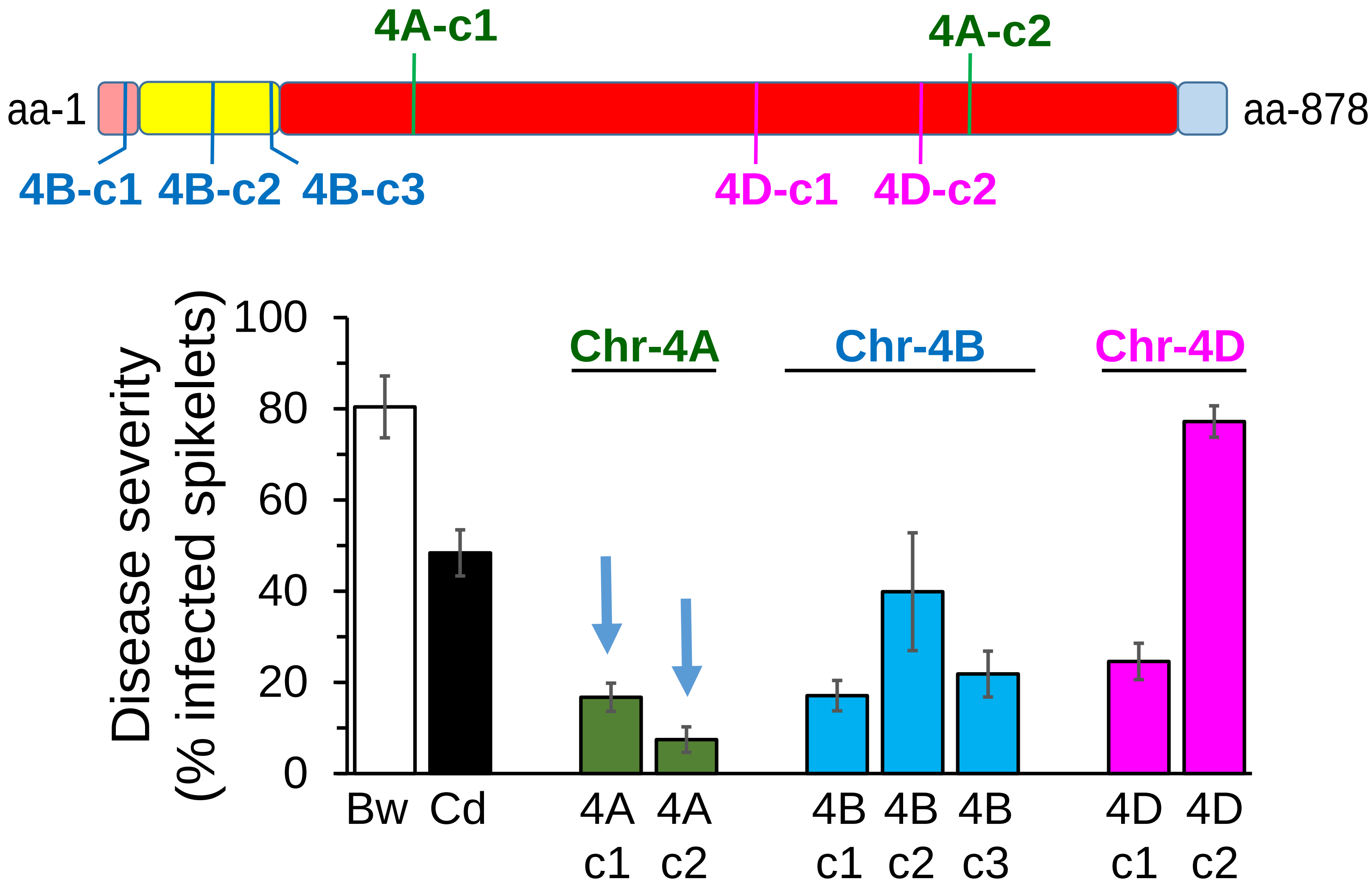


Which *Lpx3* homeolog(s) is the susceptibility factor?

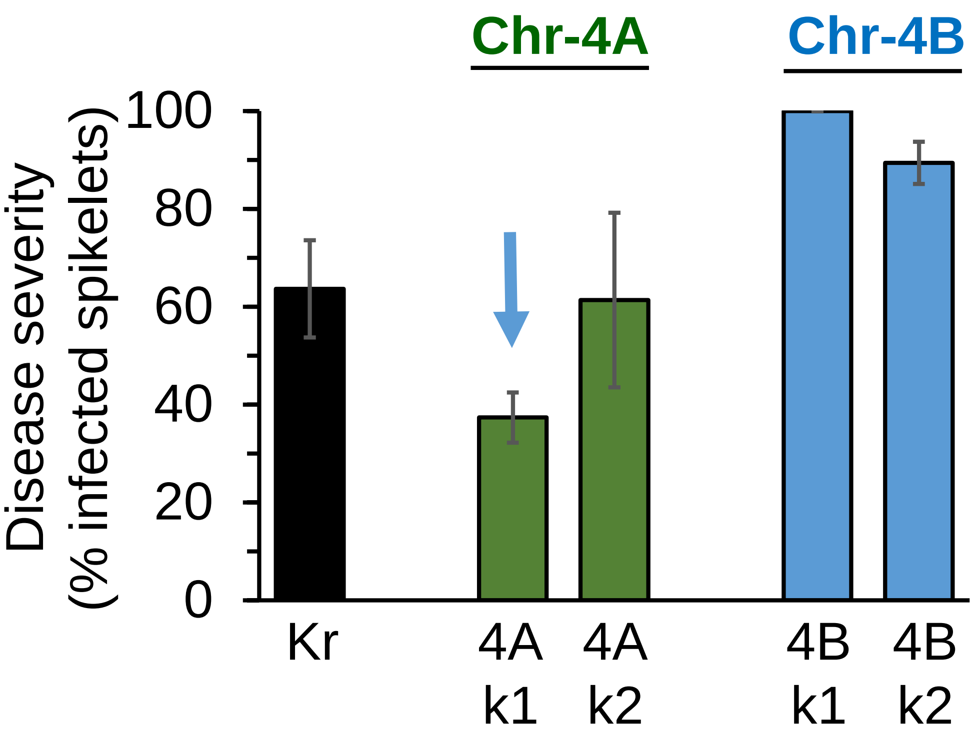
Approach: TILLING for non-sense mutations in *Lpx3* homeologs

TILLING offers a non-GMO approach to knockdown *Lpx3*

FHB severity in *Lpx3* TILLING lines – hexaploid Cadenza

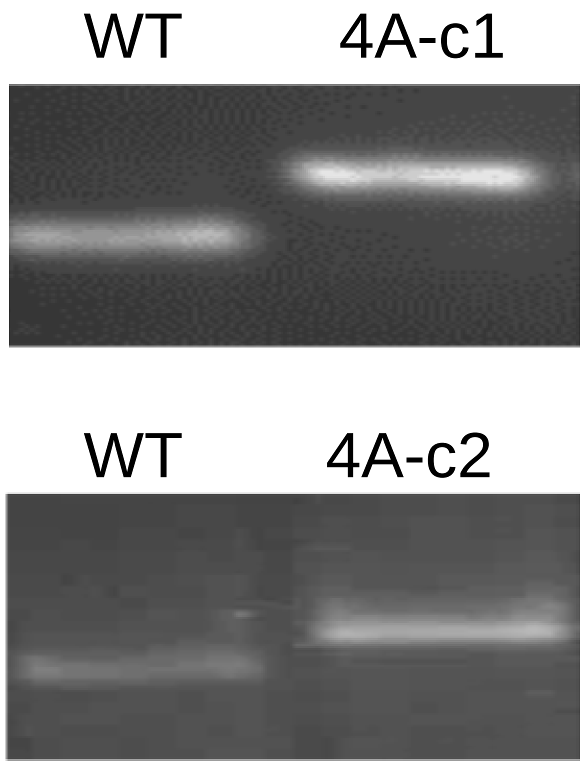


FHB severity in *Lpx3* TILLING lines – tetraploid Kronos

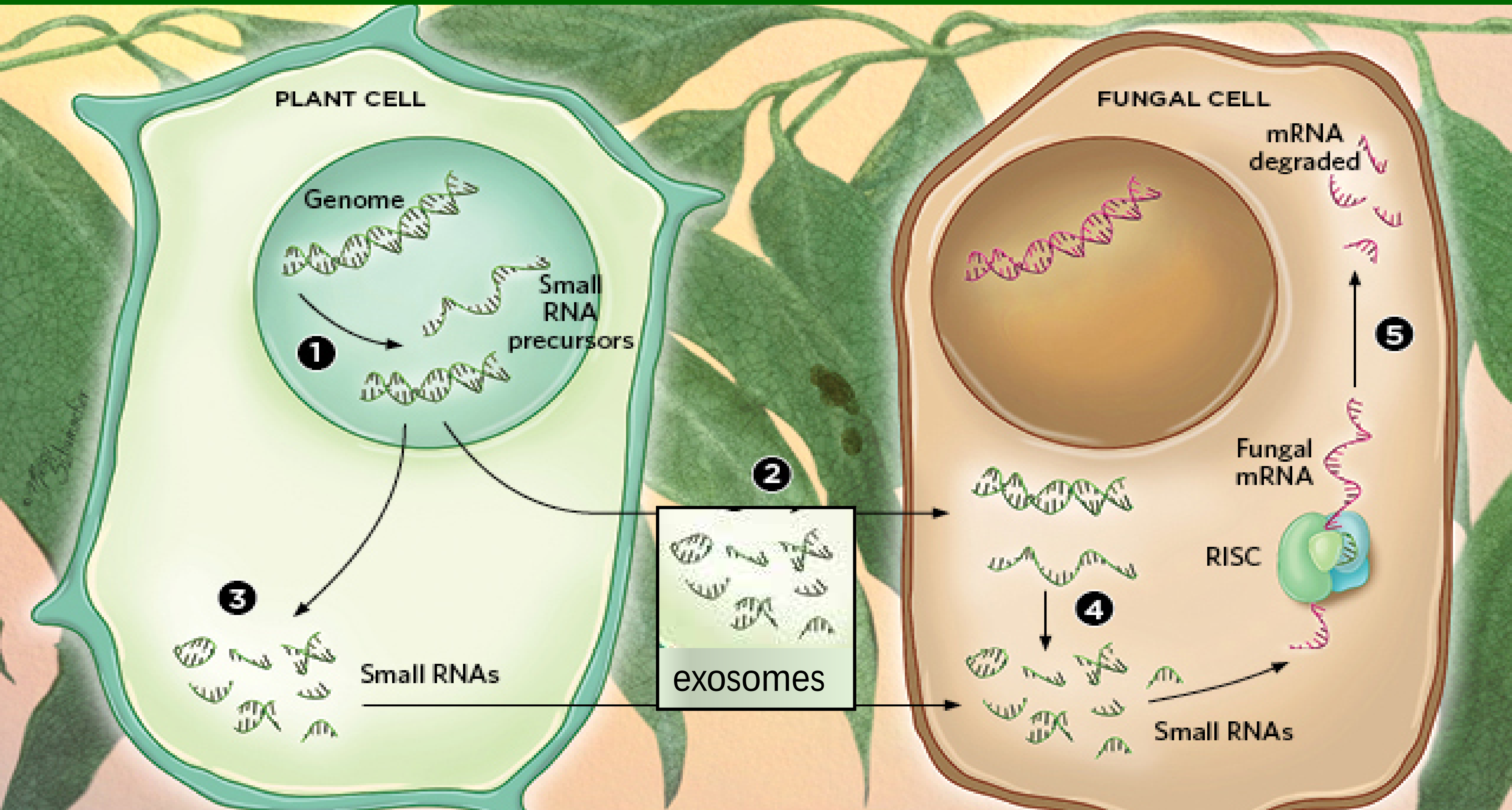


Kr 4A-k1

PCR-based codominant dCAPS markers distinguish *Lpx3* mutant alleles from the wild-type allele



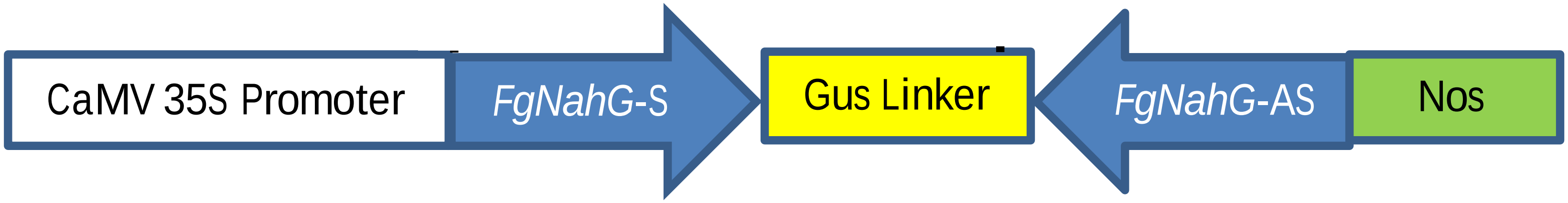
Host-induced gene silencing - targeting *Fusarium graminearum* virulence factors to promote plant resistance against *Fusarium graminearum*



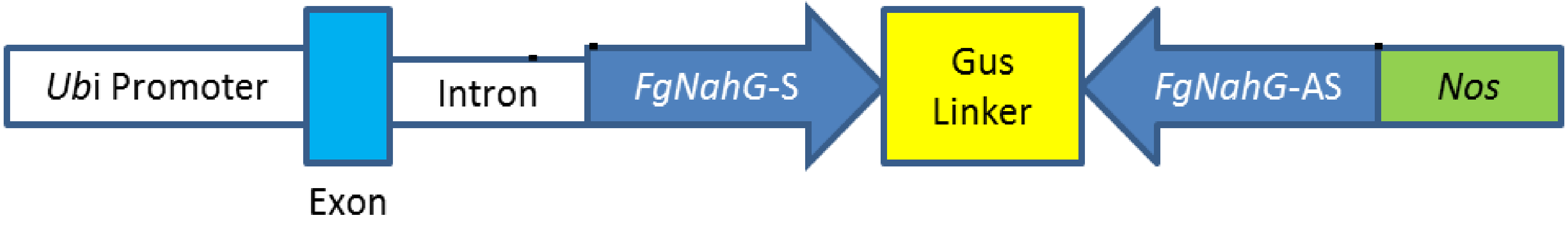
https://www.the-scientist.com/features/rna-interference-between-kingdoms-32116

RNAi constructs for HIGS-mediated knockdown of *FgNahG* and *FGL1* expression in *Fusarium graminearum*

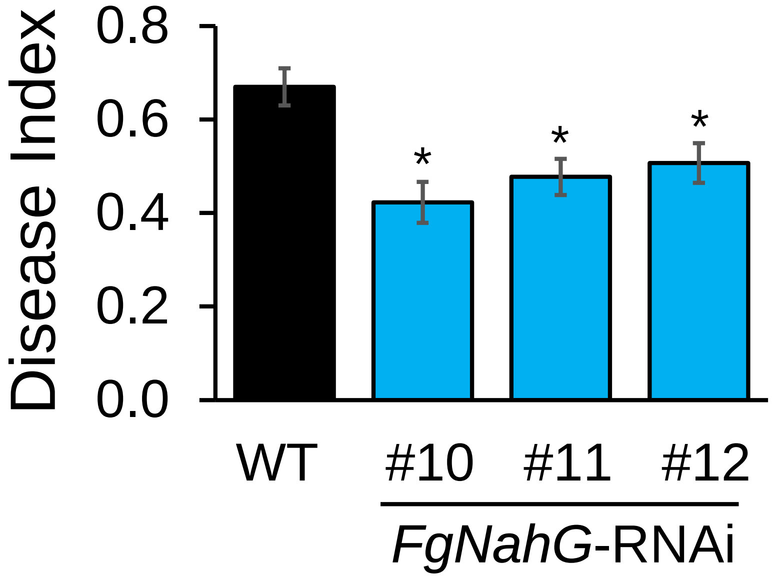
HIGS in Arabidopsis

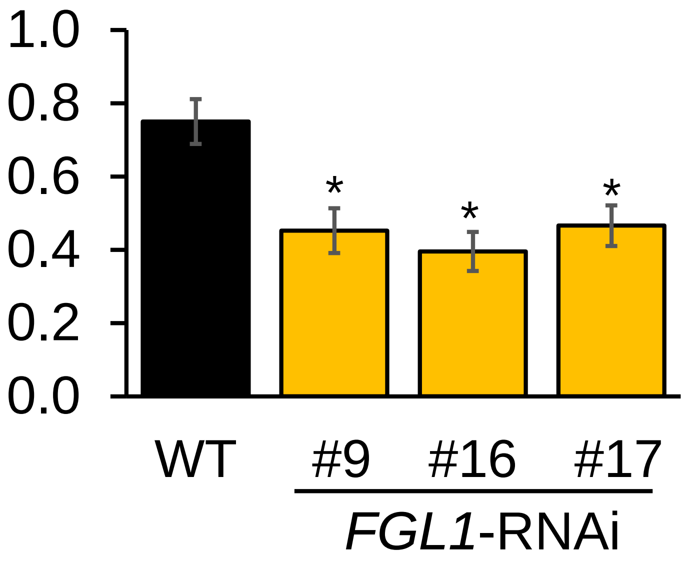


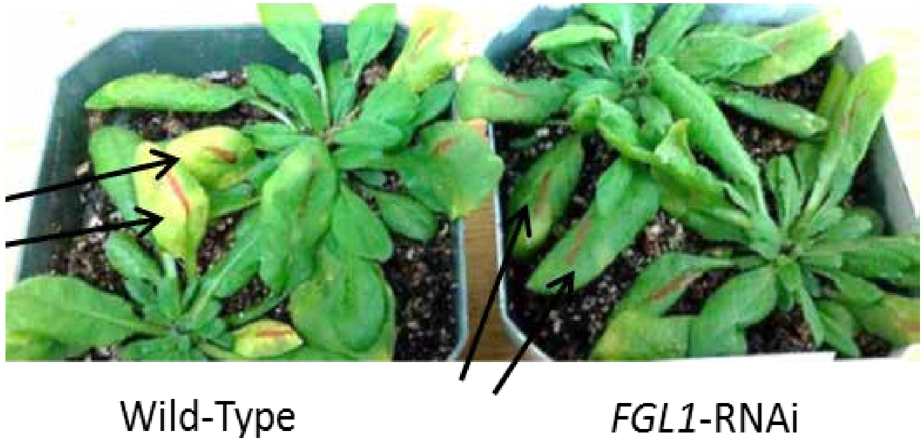
HIGS in wheat



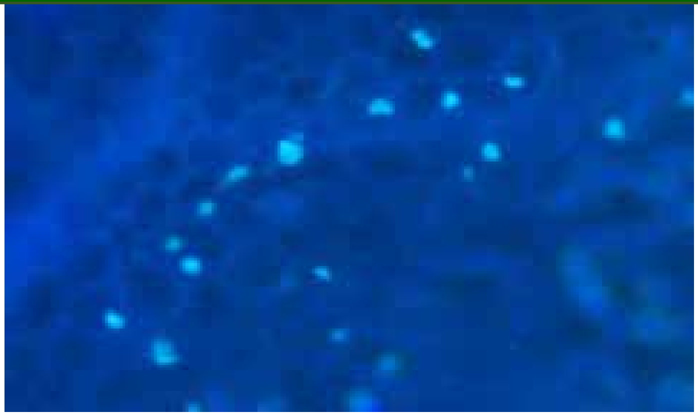
FgNahG-RNAi and *FGL1*-RNAi expressing Arabidopsis exhibit enhanced resistance to *Fusarium graminearum*

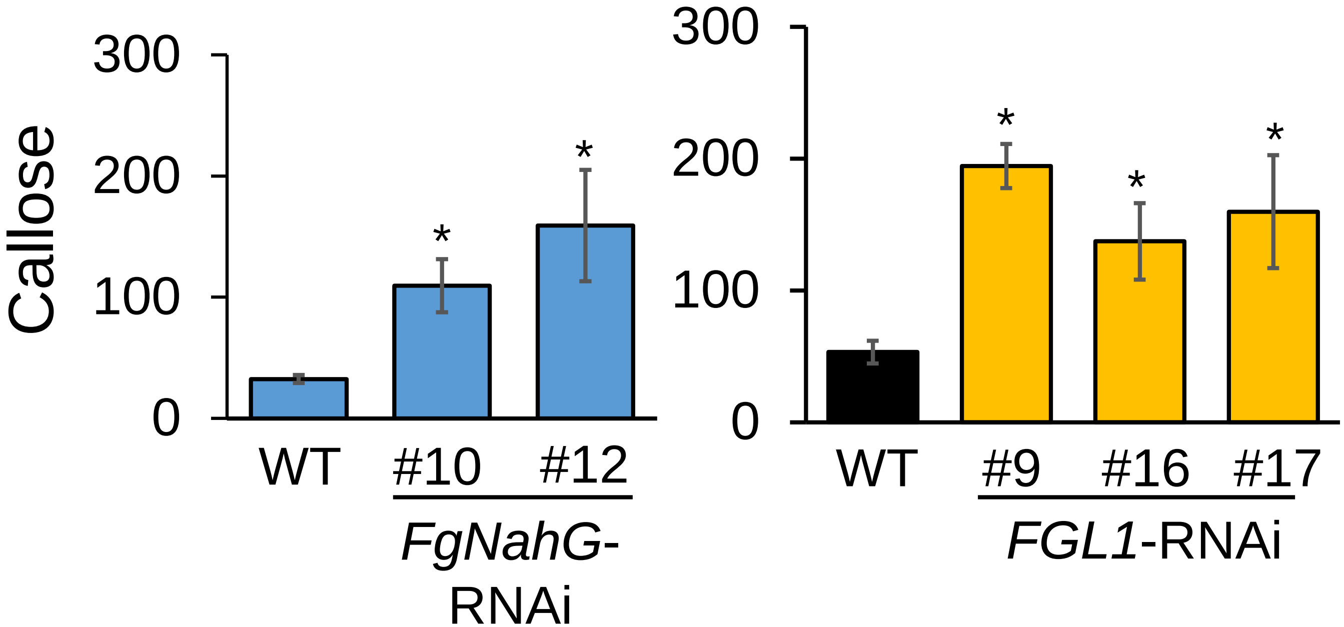




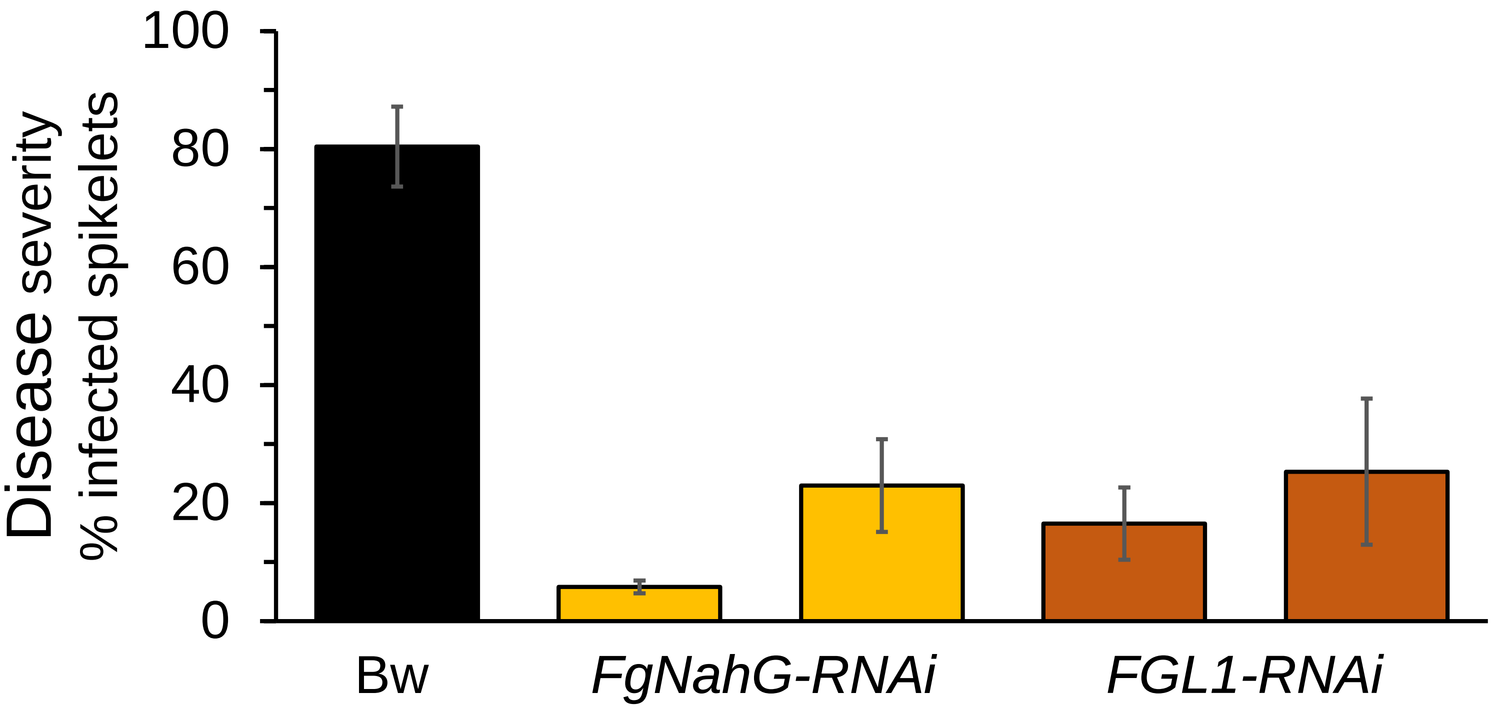


FgNahG-RNAi and *FGL1*-RNAi Arabidopsis respond to *Fusarium graminearum* infection with stronger callose deposition





FHB severity is reduced in *FgNahG*-RNAi and *FGL1*-RNAi hexaploid wheat



Key points

Host genes that contribute to susceptibility can be targeted for knock-down to enhance plant resistance to *Fusarium graminearum*

- Knock-down of the wheat 9-LOX *Lpx3* function by RNAi or non-sense mutations confers enhanced FHB resistance
- HIGS provides a mechanism to target the fungal virulence genes *FgNahG* and *FGL1* for promoting FHB resistance

Acknowledgements

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Agricultural Research Service

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