RESEARCH ARTICLE

WILEY

The phytopathogen *Xanthomonas campestris* utilizes the divergently transcribed *pobA/pobR* locus for 4-hydroxybenzoic acid recognition and degradation to promote virulence

Bo Chen[1] Rui-Fang Li[2] Lian Zhou[3] Jia-Hui Qiu[1] Kai Song[1] Ji-Liang Tang[4]
Ya-Wen He[1]

Correspondence

Funding information

Abstract

Xanthomonas campestris *campestris* *Xcc*
Xcc
β
Xcc
Xcc *pobA* *pobR*
pobA
Xcc *pobA*
pobA *pobR*
pobA *pobR* *Xcc*
Δ*pobR*
Xcc

KEYWORDS

pobA *pobR* *Xanthomonas campestris*

1 INTRODUCTION

et al *et al* *Xcc*

Xanthomonas campestris *campestris* *Xcc* *et al*
et al
Xcc
et al

Xcc

p *et al*
p
et al
et al

Brassica

et al
Xcc

et al

et al

ortho *β* *meta*
et al
β

Azotobacter chroococcum *Pseudomonas* *Rhizobium*
leguminosarum *Acinetobacter calcoaceticus* *Cupriavidus necator*
et al *et al*

pobA
Xcc

β *et al*

FIGURE 2 *pobR/pobA*

pobR pobA

Xcc

pobA

pobR

2.2 The pobA/pobR locus is essential for 4-HBA degradation in XC1

pobR *pobR*

pobA *pobR*
pca *pobA*
pobR
pobA *pobR*

Δ*pobA* Δ*pobR*
pobA *pobR* Δ*pobRA*

pobA Δ*pobRA*
pobR Δ*pobRA*

Δ*pobA* Δ*pobR* Δ*pobRA*
pobA
pobR *pobA*
Δ*pobRA*
pobR

2.3 Defining the overlapping promoters of pobA and pobR

Xcc

pobA *pobR*

pobA

E coli σ

et al
pobR

FIGURE 3 *pobA*

gusA
μ
gusA
Δ*pobR*

p *p*
p

Δ*pobR* *gusA* *pobA*
pobA
Δ*pobR* Δ*pobRA* Δ*pobRA pobR*
pobA

2.5 pobR is transcribed in the absence of 4-HBA, the presence of 4-HBA advances its expression

pobR *gusA*

gusA

gusA

gusA

gusA

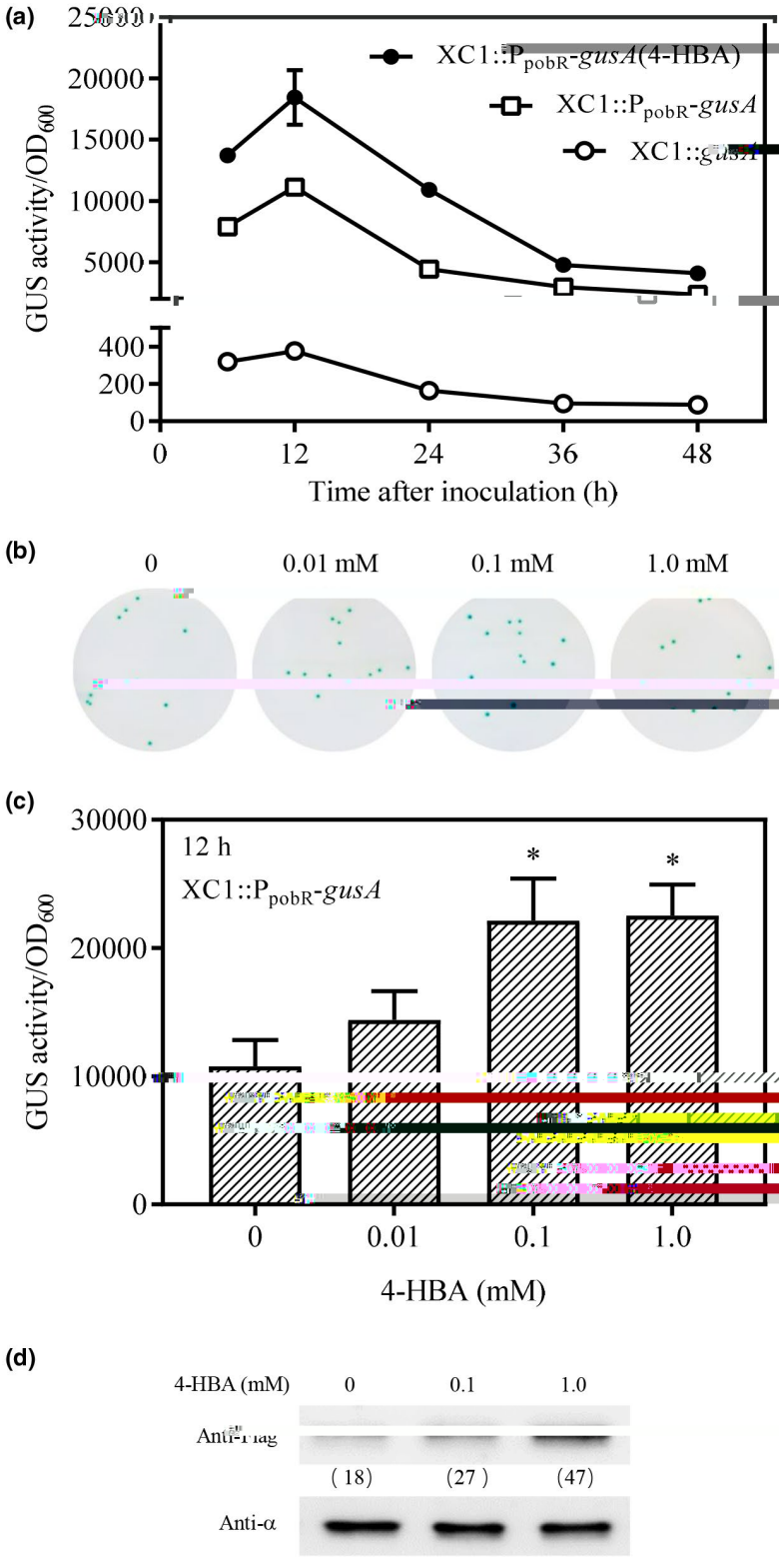

FIGURE 4 *pobR*

gusA

μ

α

p

μM

μM

μM

μ μ μ μ

μ

± ±

±

±

pobR *Xcc*

Xanthomonas

2.8 PobR specifically binds to a 25-bp site within the overlapping promoters

pobA *pobR*

TABLE 1

Mutation	Dimerization	4-HBA binding (Kd) (μM)	4-HBA degradation ratio (%) at 18 hpi
	±	±	
	±		±
	±	±	
	±		
	±	±	±
	±		
	±	±	±
			±

Note: *p*

Xcc

Xcc
pobA *pobR*
gusA *gusA*

2.9 Both pobR and pobA are transcribed during XC1 infection inside Chinese radish

pobR
pobA *Xcc*
Xcc in planta

2.10 pobR is required for full pathogenicity of XC1 in Chinese radish and cabbage

3 DISCUSSION

Xcc

Xcc

pobA *pobR*

pobA *pobR*

FIGURE 8 *pobR* *pobA*

gusA

Xcc *gusA*

pobR *pobA*

Xcc

Xcc

3.1 Biochemical basis for 4-HBA recognition and PobR dimerization

Streptomyces

et al

Acinetobacter

et al

S coelicolor

et al

Xcc

et al

Acinetobacter

S coelicolor *Xcc*

Acinetobacter *S coelicolor*

pobA

S coelicolor *et al*

et al

Xcc

Xcc

Streptomyces

et al

Xcc

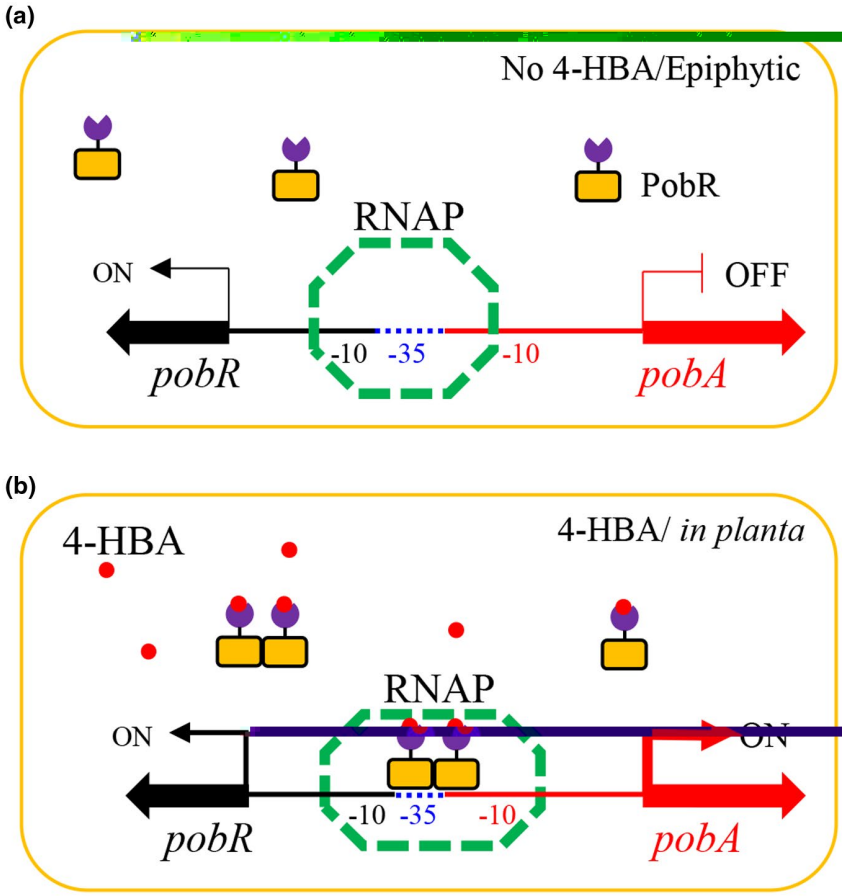

FIGURE 9

pobA *Xcc* *Xcc*
Xcc

pobR

pobA *in planta*
Xcc

pobA *pobR*

. *E.*

coli

pobA *pobR*

μ μ μ
μ

4 EXPERIMENTAL PROCEDURES

4.1 Bacterial strains and culture conditions

Xcc

4.2 Gene deletion and functional complementation analysis

Xcc

et al

4.3 Point mutagenesis of target gene in plasmid DNA and in Xcc chromosome

4.9 Electrophoretic mobility shift assay (EMSA) and DNase I footprinting sequencing assay

et al

pobA

μ

×

×

et al

4.10 Isothermal titration calorimetry analysis

=

μ

μ

4.11 We

4.14 Virulence assay in Chinese radish and cabbage

Xcc *Raphanus sativus*

×

4.15 Statistical analysis

$p =$

$p <$

ACKNOWLEDGMENT

CONFLICT OF INTEREST

AUTHOR CONTRIBUTIONS

ORCID
Ya-Wen He

REFERENCES

p
pobA
Pseudomonas putida *Microbiology* *147*

Nature Reviews Microbiology *2*

Nature Reviews Microbiology *14*

Xanthomonas
FEMS Microbiology Reviews *34*

Pseudomonas aeruginosa *Nature Protocols* *1*

p

Acinetobacter calcoaceticus *Journal of Bacteriology* *176*

Xanthomonas campestris *campestris*
Scientific Reports *6*
et al

Pseudomonas aeruginosa *Molecular*
Microbiology *104*

Arabidopsis thali-