The NSm of Tomato Spotted Wilt Virus Is an Elicitor of RTSW-Mediated Extreme Resistance in Tobacco

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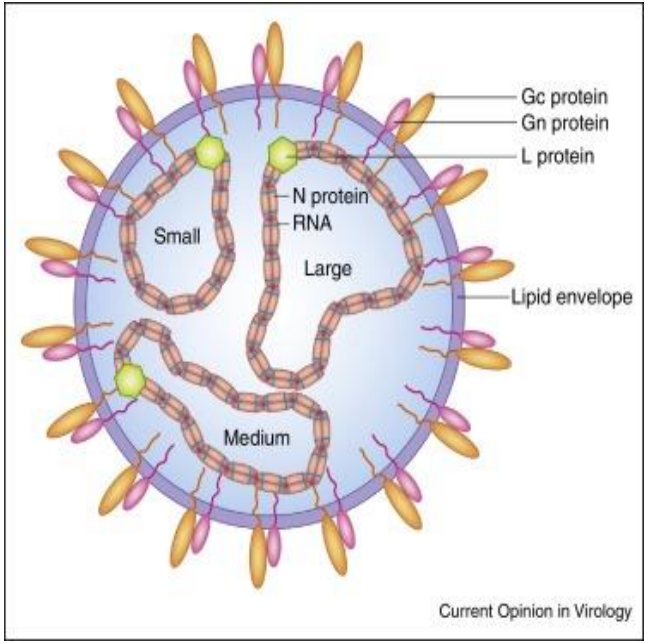
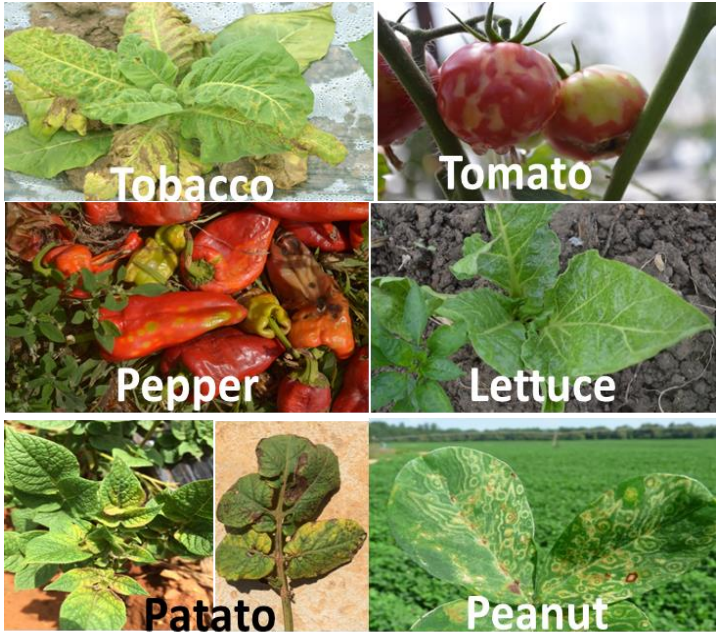
Background

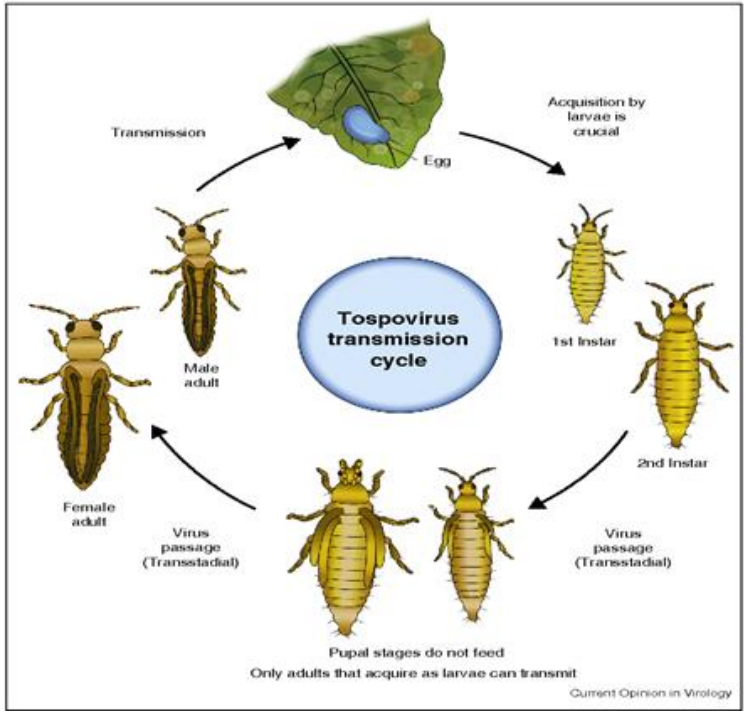
Tomato spotted wilt virus (TSWV)

- Worldwide distribution
- Causes severe economic losses in crops
- Emerging threats to tobacco yield in China





TSWV is exclusively transmitted by thrips



Thrips:
small size, rapid developmental time, high reproductive rate and development of insecticide resistance

- **Utility of natural resistance genes is an attractive approach**

Sw-5b in tomato and *Tsw* in pepper

Molecular Breeding **7:** 151–161, 2001.

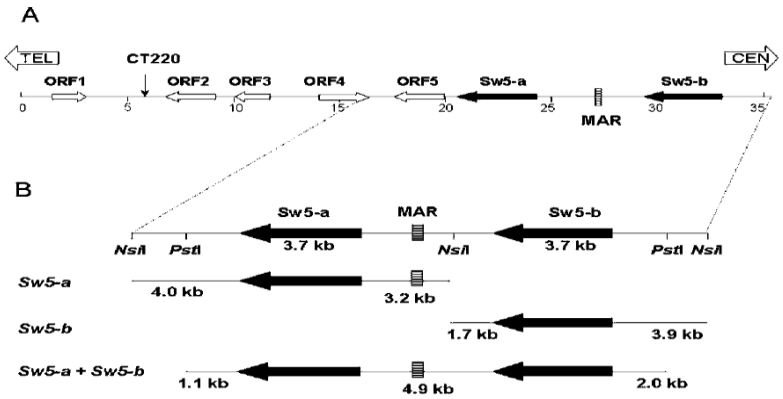
The tomato gene *Sw5* is a member of the coiled coil, nucleotide binding, leucine-rich repeat class of plant resistance genes and confers resistance to TSWV in tobacco

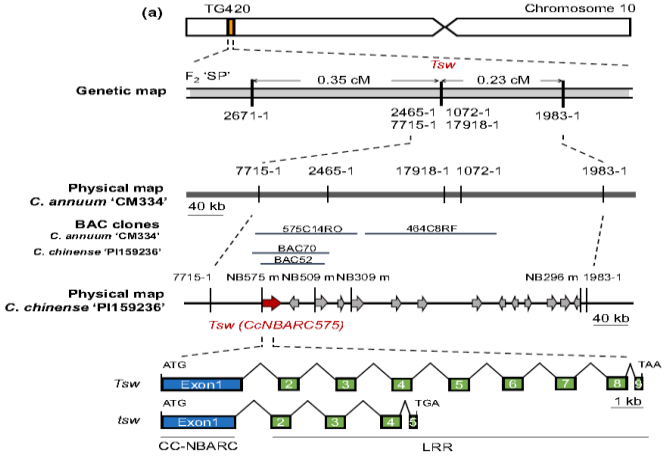
Mariana I. Spassova, Theo W. Prins[1], Rolf T. Folkertsma[1], René M. Klein-Lankhorst[2], Jacques Hille, Rob W. Goldbach[1] & Marcel Prins[1*]
Department Molecular Biology of Plants, Groningen University, Kerklaan 30, 9751 NN Haren, Netherlands; [1]Laboratory of Virology, Wageningen University, Binnenhaven 11, 6709 PD Wageningen, Netherlands;

New Phytologist
Research

Divergent evolution of multiple virus-resistance genes from a progenitor in *Capsicum* spp.

Saet-Byul Kim[1]*, Won-Hee Kang[1,2]*, Hoang Ngoc Huy[1], Seon-In Yeom[2], Jeong-Tak An[1], Seungill Kim[1], Min-Young Kang[1], Hyun Jung Kim[3], Yeong Deuk Jo[1,4], Yeaseong Ha[1], Doil Choi[1] and Byoung-Cheorl Kang[1]
[1]Department of Plant Science, Plant Genomics and Breeding Institute, Research Institute for Agriculture and Life Sciences, Seoul National University, Seoul 151-921, Korea; [2]Department of Horticulture, Institute of Agriculture & Life Science, Gyeongsang National University, Jinju 660-701, Korea; [3]Department of Eco-Friendly Horticulture, Cheonan Yonam College, Cheonan 331-709, Korea; [4]Korea Atomic Energy Research Institute, Jeongeup 580-185, Korea





Nicotiana alata, complete resistance to TSWV (RTSW)

Species	Symptoms	ELISA positive plants/total tested plants	Symptom severity index
Section: *Alatae*			
N. alata var. *alba* (from Oslo)	HR/SHR	03/10	0/3
N. alata (from Oslo)	HR	00/15	0
N. alata (from Warsaw)	HR	00/16	0
N. alata var. *grandiflora* (from Vilnius)	HR/SHR	08/16	0/2
N. alata var. *grandiflora* (from Bergerac)	HR/SHR	05/16	0/2
N. alata (from Scafati)	HR/SHR	03/15	0/2
N. alata 'Biały Narcyz' (breeding in Warsaw)	HR/SHR	01/16	0/3
N. forgetiana	SHR	10/10	3
N. langsdorfii	S	06/06	3
N. longiflora	S	06/06	2
N. plumbaginifolia	S	06/06	3

N. tabacum × *N. alata*

↓

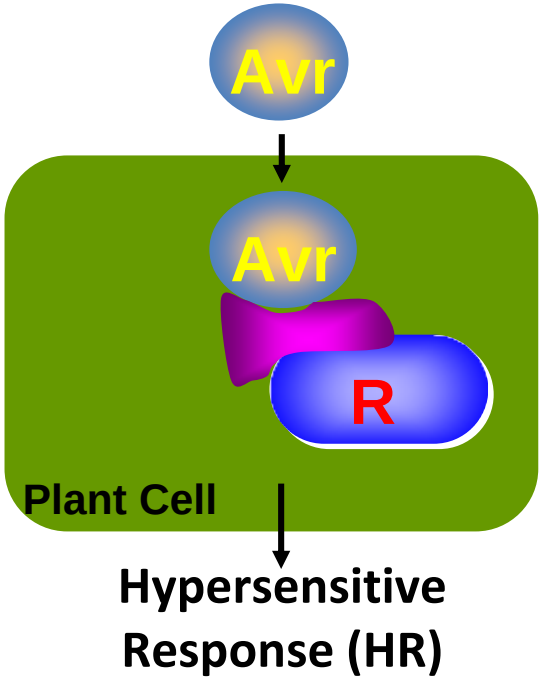
F1 hybrid × *N. otophora* Grisebach (bridging parent)

↓

Polalta

Opoka .,1969;
Gajos., 1981;
Gajos., 1987

Gene-for-gene Model (R-Avr)



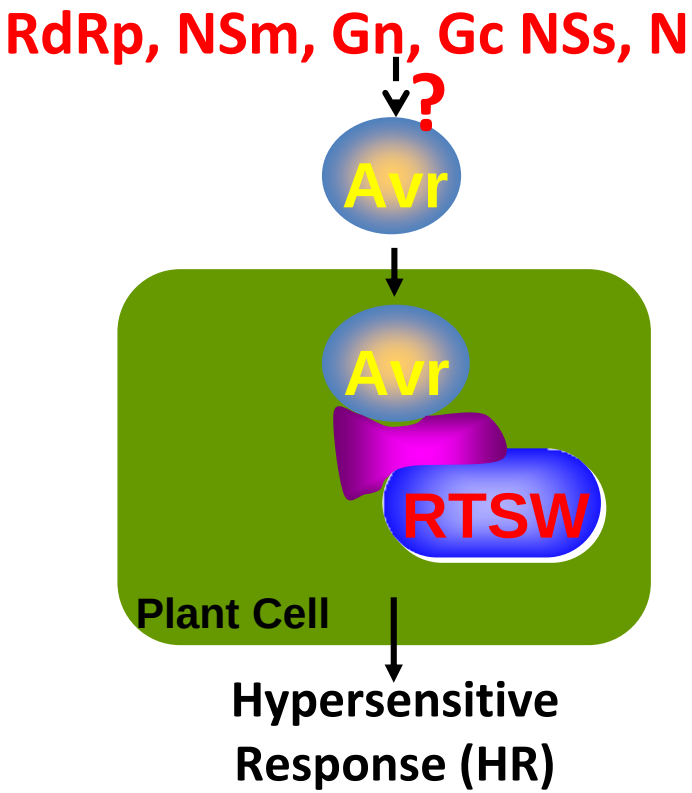
TMV

p50

TMV

1 whether RTSW mediated resistance is a typical R gene resistance?

2 Which gene plays as an Avr factor against RTSW?

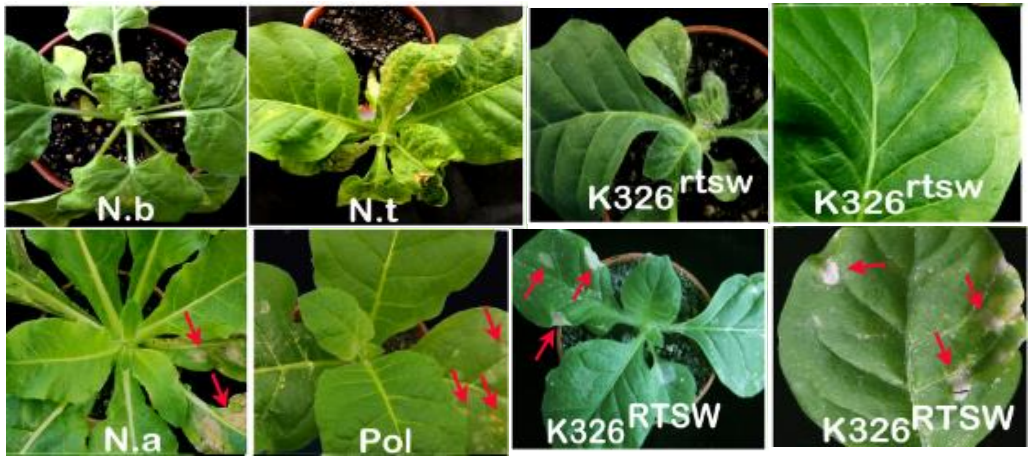


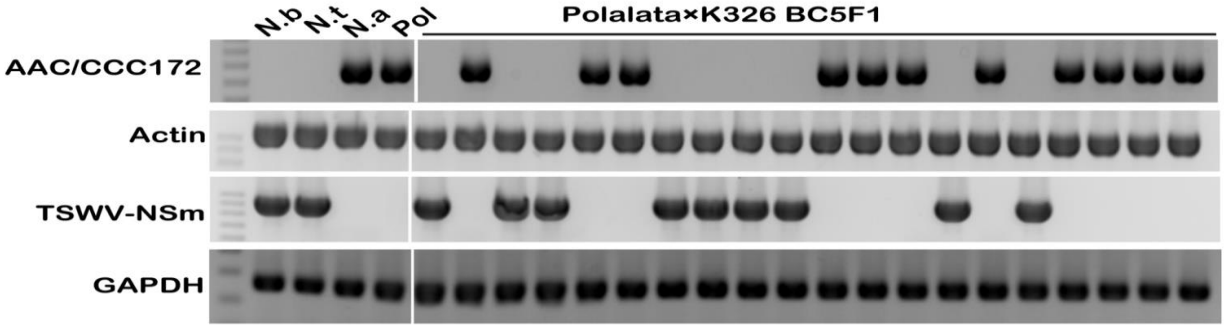
Results

1 Tobacco *RTSW* confers resistance to TSWV by a hypersensitive response (HR) manner

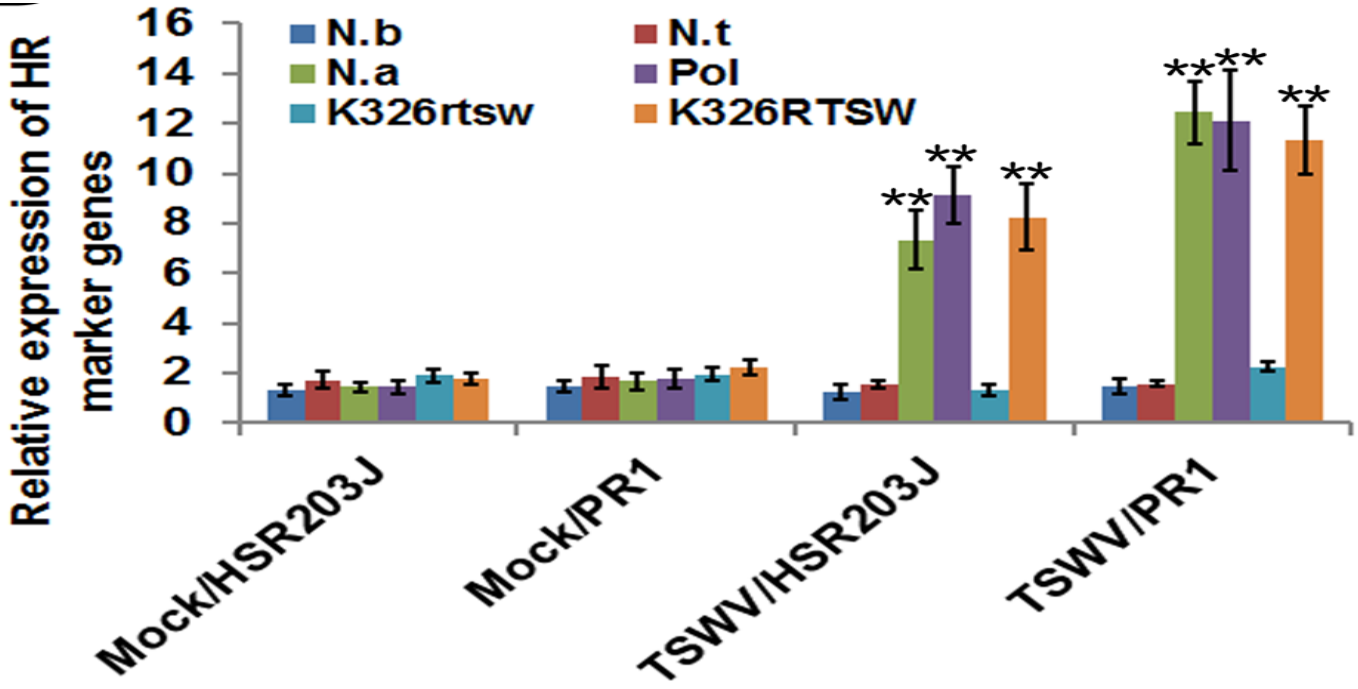
Susceptible

Resistance

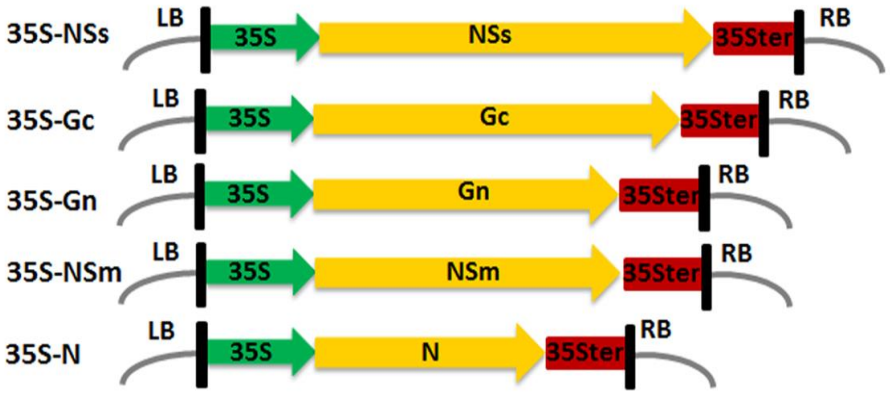


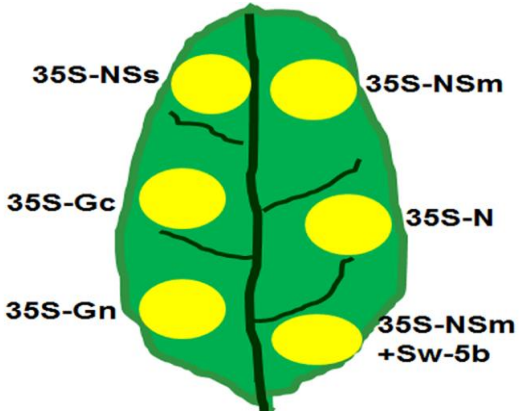


HR marker genes are specifically and dramatically elicited

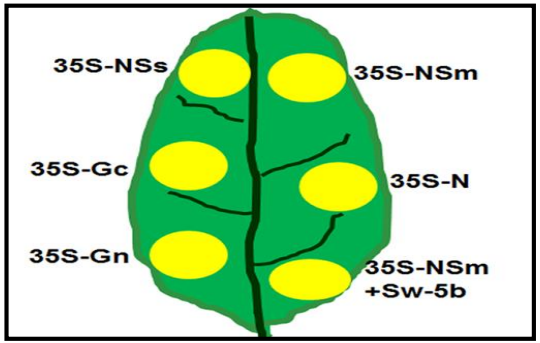


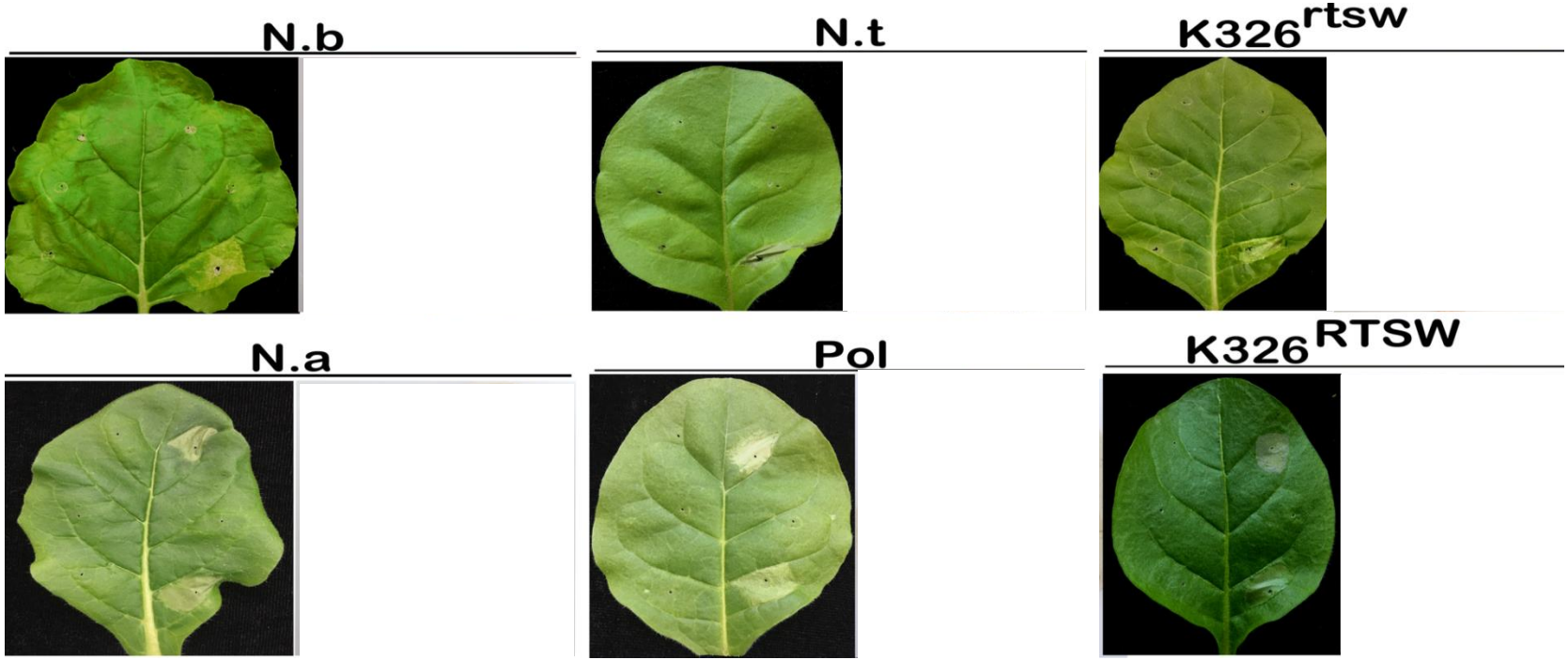
2 Identification of elicitor of RTSW-based resistance to TSWV



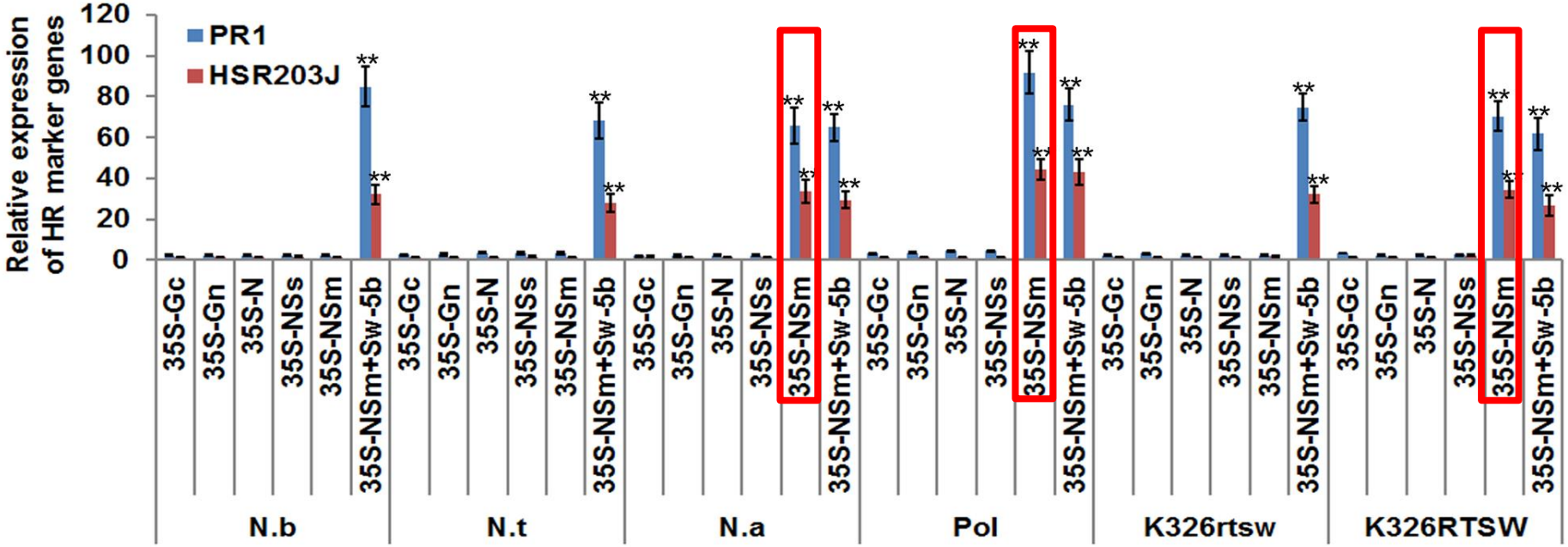


Only the construct expressing NSm elicited necrotic local lesions and induced H_2O_2 burst in RTSW-harboring tobacco

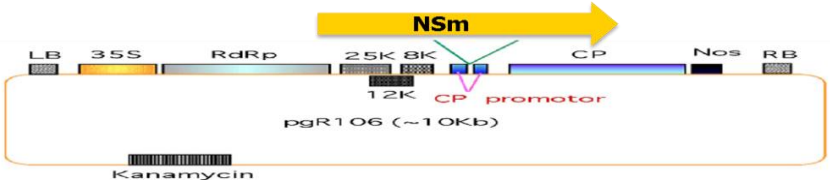


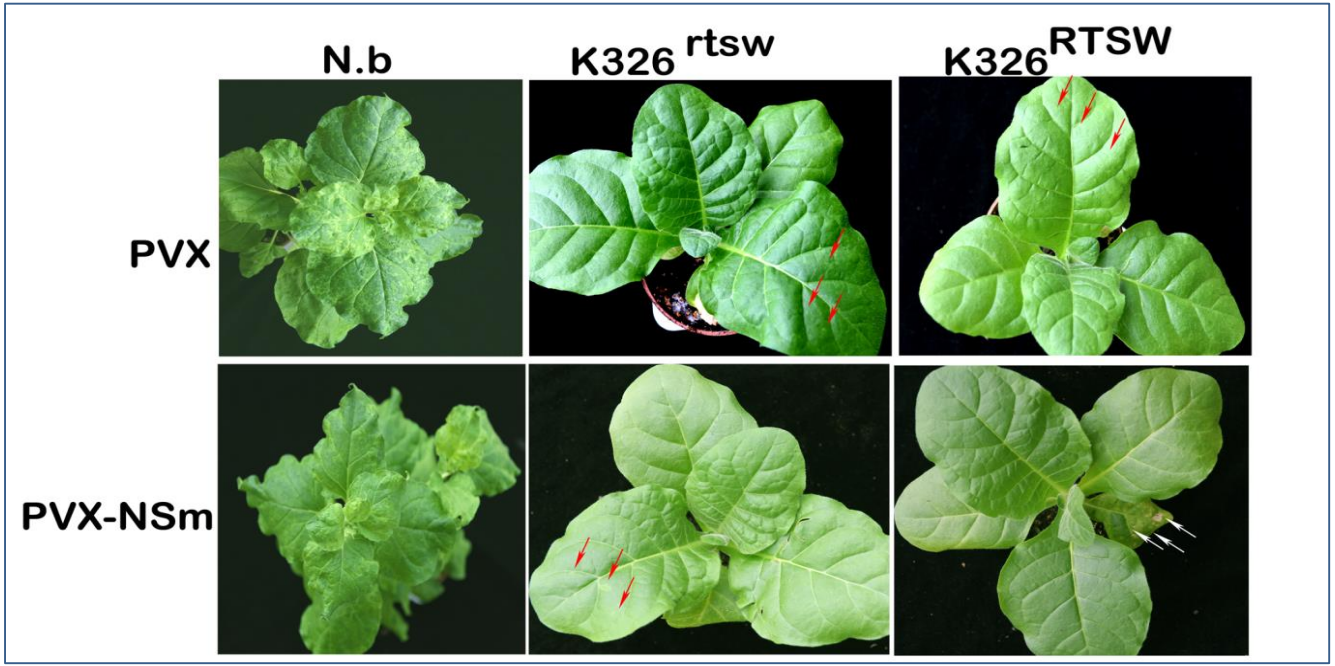


NSm protein is an elicitor of expression of HR marker gene

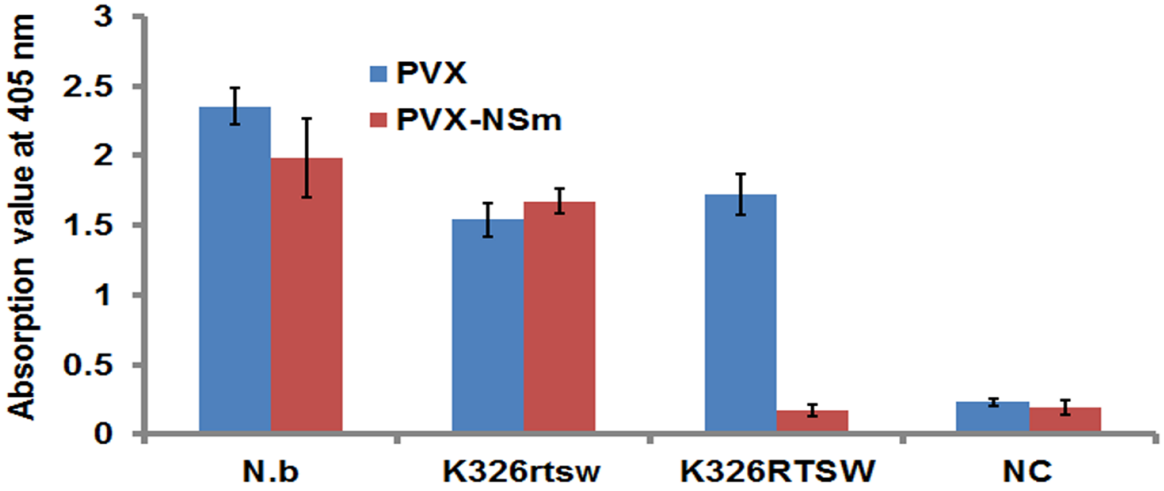


TSWV NSm elicits HR in a PVX expression assay against RTSW



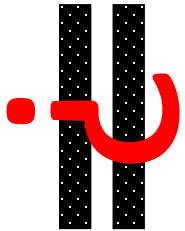


PVX-NSm elicits HR type cell death to prevent systemic infection and result in virus arrest in inoculation leaf



NSm protein is an elicitor of RTSW-based resistance to TSWV

NSm = Movement protein



NSm = Avr factor

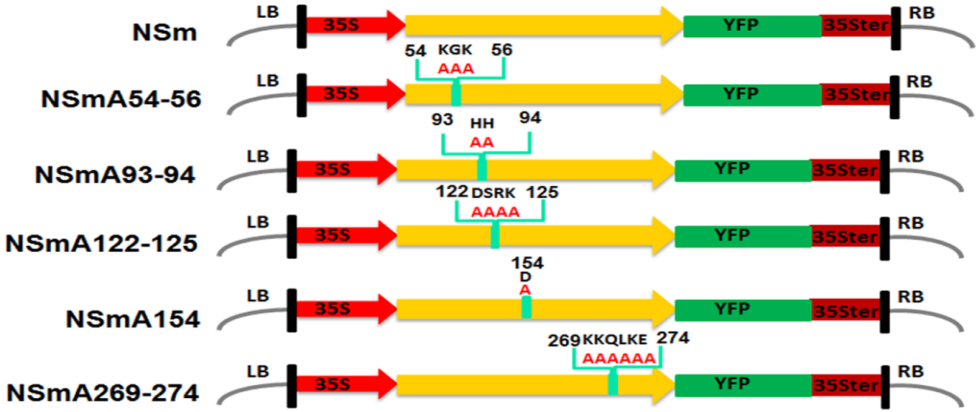
Li et al., 2009;
Lewandowski and Adkins, 2005

3 The relationship of function of NSm for induction of HR and its movement

Identification of domains of the Tomato spotted wilt virus NSm protein involved in tubule formation, movement and symptomatology

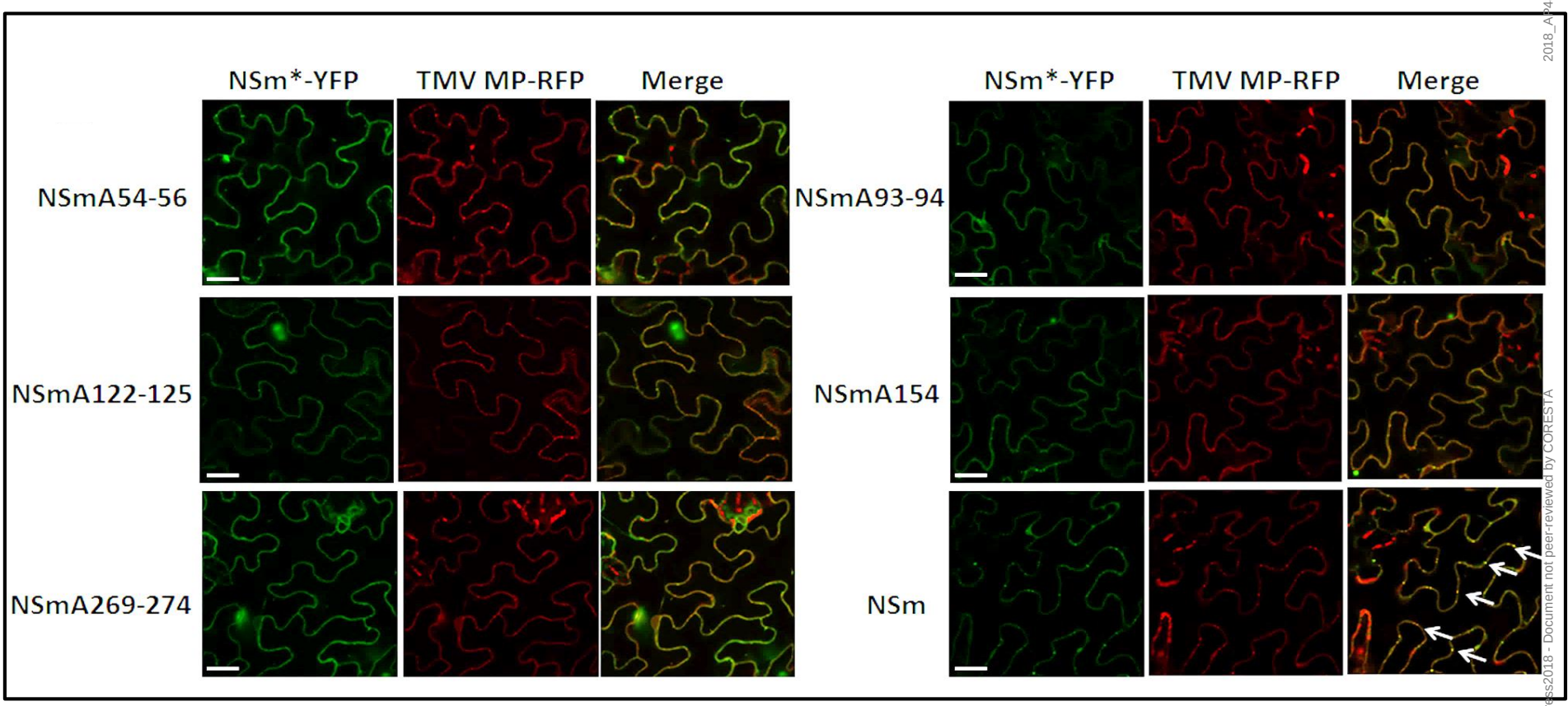
Weimin Li [a,1], Dennis J. Lewandowski [b], Mark E. Hilf [c], Scott Adkins [c,*]

[a] University of Florida, Citrus Research and Education Center, Lake Alfred, FL 33850, USA
[b] Department of Plant Pathology, Ohio State University, Columbus, OH 43210, USA
[c] United States Department of Agriculture, Agricultural Research Service, 2001 South Rock Road, Fort Pierce, FL 34945, USA

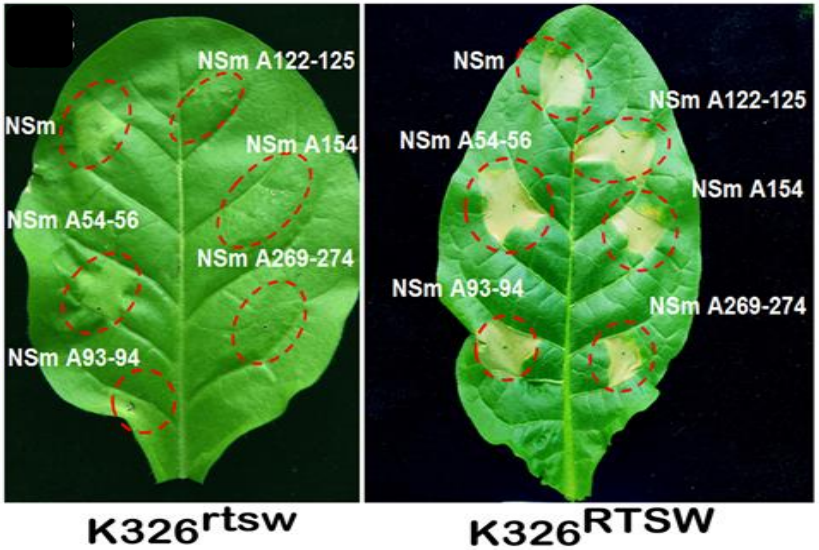


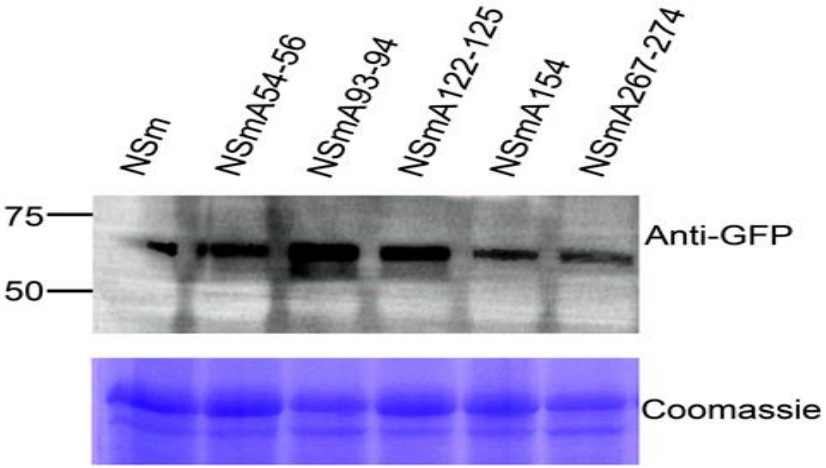
Li et al., 2009;

None of the mutant NSm proteins was able to target PD



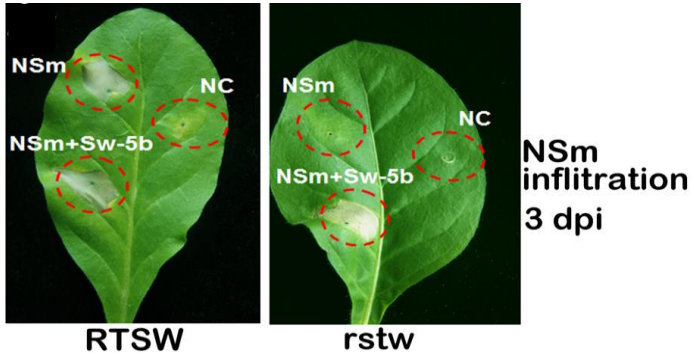
NSm mutants kept the ability of HR elicitation in tobacco leaves in the presence of RTSW as wild-type



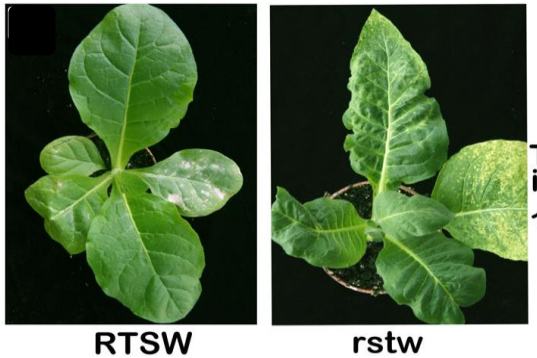


Function of NSm to target PD and to traffic between cells is uncoupled from its function to trigger RTSW-mediated HR.

4 Establishment of an Avr-gene-based diagnosis



NSm infiltration 3 dpi



TSWV inoculation 15 dpi

Summary

- NSm is Avr of RTSW in the TSWV
- The HR-triggering function of NSm is independent of its movement function
- An Avr-gene-based diagnosis in context of RTSW was established to develop a rapid method for disease resistance determination.

Acknowledgement

Collaborator

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Group member

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Thank you for your attention!