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A novel *Meloidogyne incognita* effector Mi-ISC-1 promotes parasitism by disrupting salicylic acid biosynthesis in host plants

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Introduction

The root-knot nematode *Meloidogyne incognita* is one of the most important plant parasitic nematodes worldwide, and causes great economic losses in agricultural crops. This parasite can suppress host defense responses, and facilitate infection by secreting effectors that expressed in esophageal glands of nematodes. The salicylic acid (SA) has been recognized as a critical signaling molecule in the defense responses of many plant species. There are two distinct metabolic processes for SA synthesis in plants, one is the phenylalanine ammonia-lyase (PAL) pathway and another is the isochorismate synthase (ICS) pathway. We described a novel effector of *M. incognita*, named Mi-ISC-1, which is a member of the isochorismatase (ISC) protein family. We aim at exploring the function of Mi-ISC-1 in nematode parasitism.

Results

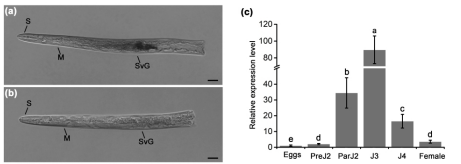

FIGURE 1 Spatial and temporal expression patterns of *Mi-isc-1*.

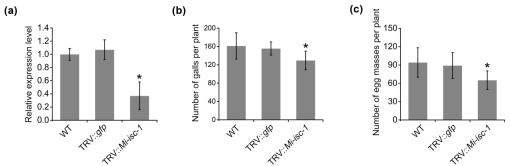

FIGURE 2 In planta RNA interference of *Mi-isc-1* affects *Meloidogyne incognita* parasitism.

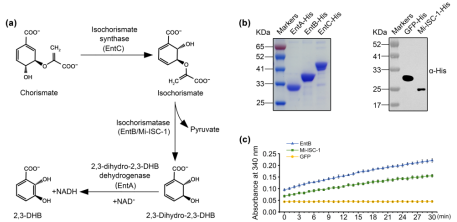

FIGURE 3 Mi-ISC-1 can catalyse the hydrolysis of isochorismate in vitro.

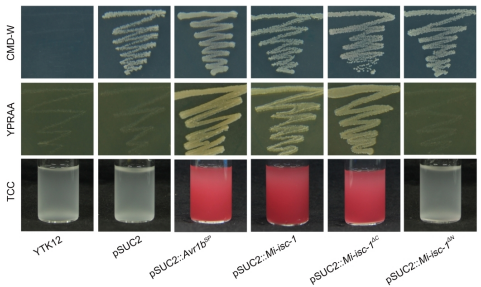

FIGURE 4 Validation of Mi-ISC-1 secretion using the yeast secretion trap assay.

Results

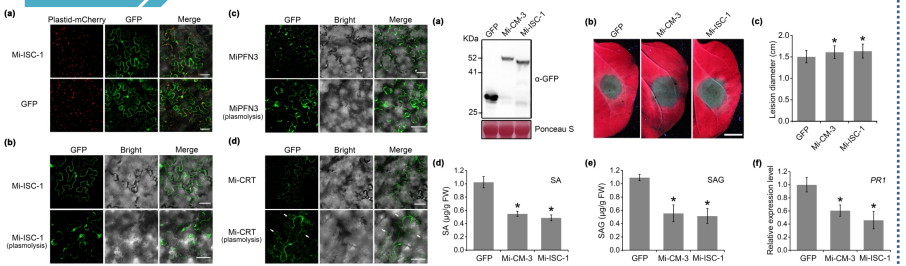

FIGURE 5 Subcellular localization of Mi-ISC-1 in plant cells.

FIGURE 6 Transient expression of Mi-ISC-1 suppresses SA-mediated disease resistance.

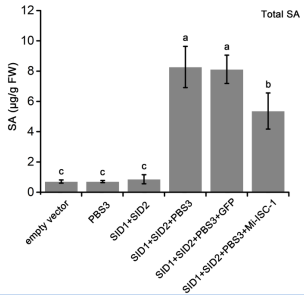

FIGURE 6 Mi-ISC-1 affects the production of SA via the reconstitution of de novo SA biosynthesis in *Nicotiana benthamiana*.

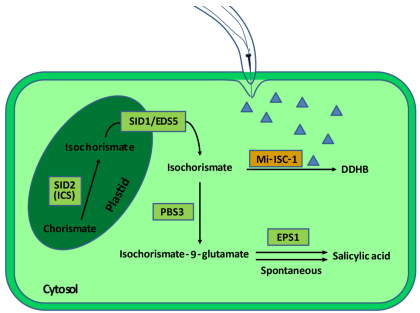

FIGURE 7 Proposed model of Mi-ISC-1 subverting plant SA biosynthesis to suppress plant immunity.

Conclusion

In the present study, analysis of temporal and spatial expression patterns as well as tobacco rattle virus (TRV)-mediated gene silencing revealed that *Mi-isc-1* may be important in nematode parasitism. Enzyme activity assays showed that Mi-ISC-1 can catalyse hydrolysis of isochorismate. Although the protein encoded by *Mi-isc-1* lacks a predicted signal peptide (SP) for secretion, a yeast secretion trap assay showed that it can be secreted from eukaryotic cells. Transient expression analysis further demonstrated that Mi-ISC-1 was localized within the cytoplasm of plant cells and can compromise the SA-mediated resistance to *Phytophthora capsici* on *N. benthamiana*. Moreover, Mi-ISC-1 suppressed the production of SA following the reconstitution of the de novo SA biosynthesis via the isochorismate pathway in *N. benthamiana* leaves. Our results reveal that *M. incognita* uses a functional isochorismatase to promote parasitism by disrupting SA biosynthesis in host plants.

Acknowledgements

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