Секция «Вирусология»

Molecular Regulation of Host Defense Responses Mediated by Biological Anti-TMV Agent ϵ-poly-L-lysine

Научный руководитель – Liu He

he liu
PhD
Shenyang Agricultural University, Шэньян, Китай
E-mail: zm8848@list.ru

Microbes and microbial metabolites induced resistance is known to protect plants from several invaders, including fungus, bacteria and viruses etc. [1]. Our laboratory has isolated and purified ϵ-poly-L-lysine (ϵ-PL) from *Streptomyces microflavus* var. *liaoningensis* (unpublished results) with independent intellectual property rights (acceptance number 201910330737.2), and has reported its antifungal effect and its action mechanism[2]. The latest research in our laboratory also found that ϵ-PL has a good potential for anti plant viral diseases[3], but the antiviral mechanism was not to be further explored. In this study, the results showed that ϵ-PL can effectively inhibit the infection of tobacco mosaic virus (TMV) in *Nicotiana glutinosa* and *N. tabacum* cv. NC89, and can effectively delay TMV in *N. benthamiana.*, The iactivation effect and preventive effect on TMV was 90.6% and 79.3% when the *N. glutinosa* was treated with 500μg/ml ϵ-PL (Fig. 1). Fluorescence detection of *N. benthamiana* seedlings inoculated with GFP-TMV showed that the fluorescent spots in the inoculated leaves, upper leaves or parietal leaves were significantly reduced compared with the control group. The top leaves of *N. benthamiana* treated with 100 μg/ml ϵ-PL showed no fluorescent spots, while the green fluorescent areas of the control leaves were obvious. RNA accumulation of TMV-infected tobacco leaves and tobacco protoplasts treated with different concentrations of ϵ-PL were analyzed by Northern blot. The results showed that the TMV-RNA accumulation in the sample treated by ϵ-PL was significantly reduced, indicating that ϵ-PL affects the synthesis and accumulation of viral nucleic acid. Observation by transmission electron microscopy revealed that ϵ-PL can induce cleavage of virions (Fig. 2). Systemic infection and significant inhibition of virus accumulation in tobacco BY-2 protoplasts. The results of RNA-seq showed that approximately 620 and 900 differently expressed genes (DEG) were significantly up-regulated and down-regulated after treatment of BY-2 protoplasts with 5μg/ml ϵ-PL (Fig. 3). In addition, KEGG analysis indicated that various DEGs are involved in endoplasmic reticulum (ER) protein processing, suggesting a possible correlation between ER homeostasis and viral resistance. RT-qPCR was performed to verify gene expression of key DEGs related to defense, stress response, signal transduction and plant hormones, which is consistent with the results of RNA-seq. The existing reports mainly focused on ϵ-PL application in food preservatives, but its mechanism of action as a biocontrol agent against plant diseases has not been elucidated[4]. Our work showed for the first time that ϵ-PL can be used as a microbial pesticide against plant virus diseases and provides valuable insights into the antiviral mechanisms of ϵ-PL.

References

1) Ajay, K. Awanish, K. Improved microbial biosynthesis strategies and multifarious applications of the natural biopolymer epsilon-poly-l-lysine // Process Biochemistry. 2014, 49. p. 496-505.
2) Chen, J. Liu, H. Xia, Z. Zhao, X. Wu, Y. An, M. Purification and Structural Analysis of the Effective Anti-TMV Compound ϵ-Poly-l-lysine Produced by Streptomyces ahygroscopicus // Molecules. 2019, 23. p. 24-29.

3) Hu, G. Dong, Y. Zhang, J. Fan, X. Ren, F. Progress in plant viroid elimination techniques // Zhiwu Baohu Xuebao (Journal of Plant Protection). 2017, 44(2). p.177-184

4) Liu, H. Chen, J. Xia, Z. An, M. Wu, Y. Effects of ϵ-poly-l-lysine on vegetative growth, pathogenicity and gene expression of Alternaria alternata infecting Nicotiana tabacum // Pestic Biochem Physiol. 2020. 163. p.147-153.

Illustrations

Рис. 1. Anti-TMV effect on N. glutinosa treated with 500 μg/ml ϵ-PL

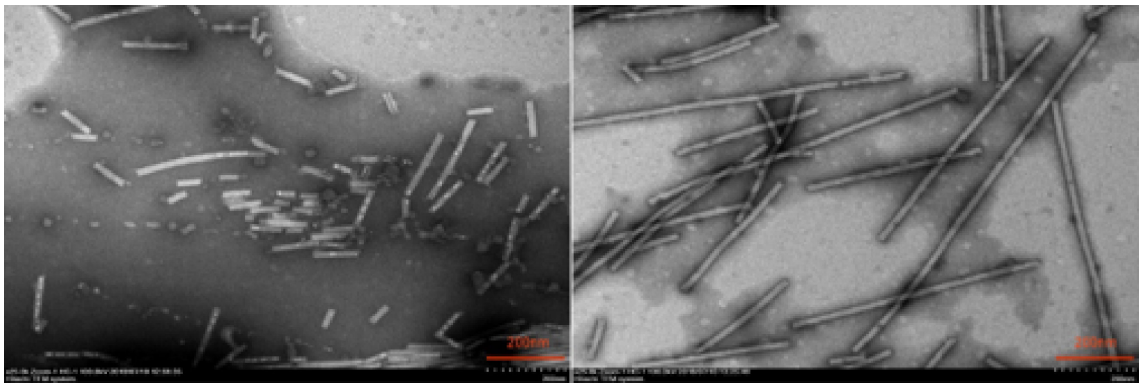

Рис. 2. Morphological changes of TMV virions under ϵ-PL treatment. The left figure was treated with 5 μg / ml ϵ-PL, the right one was treated with PBS.

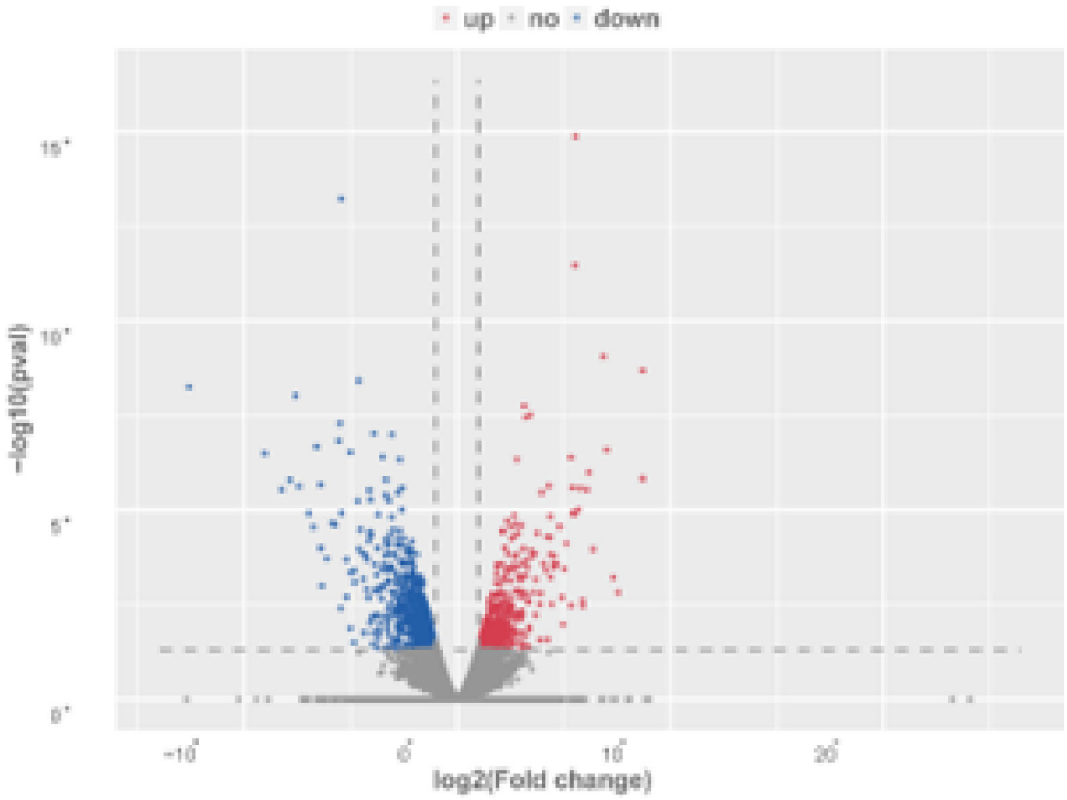

Рис. 3. Analysis of volcano maps of differential gene expression levels treated with 5μg / ml ϵ-PL.