Silencing suppressor proteins shape virus-host co-evolution

Plant viruses are amongst the most important pathogens causing huge economic losses worldwide by reducing crop quality and quantity. A better understanding of the viral infection processes and plant defense strategies is important for crop improvement.

During host-pathogen co-evolution a set of complex interactions involving virus attack and host defense has been developed. One of the most important antiviral pathways in plants is RNA silencing. RNA silencing is homology-dependent gene inactivation mechanism that serves as an “immune system” for plants to fight off the virus. To deal with host antiviral silencing response viruses evolved mechanisms to avoid or counteract this, most notably through expression of viral suppressors of RNA silencing.

Viral suppressors regulate the multiple layers of the arm race (defense, counter-defense) between host and pathogen. Although the study of VSRs was at the frontline of investigations for more than ten years, many aspects of VSR’ molecular behaviors are still elusive. It is becoming more obvious now that VSRs are not just simply blockers of RNA silencing but serve as central hub regulators to dynamically integrate connections between antiviral silencing, protein-based immunity, hormone signaling, RNA metabolism and subcellular organization. As most suppressor proteins have multiple functions, the silencing function and the non-silencing activities (e.g. coat protein, movement protein, replicase, protease etc.) need to be synchronized in order to fulfill these multiple tasks and achieve “optimal” infection. In most cases, how the silencing function and the other functions of VSRs are selected and how the interconnections between the alternative functions are maintained is not known.

Here we present host factors implicated in antiviral pathways and summarize the current status of knowledge about the diverse viral suppressors’ strategies acting at various steps of antiviral silencing in plants. Besides, we consider the multi-functionality of these versatile proteins and related biochemical processes in which they may be involved in fine-tuning the plant-virus interaction. Finally, we present the current applications and discuss perspectives of the use of these proteins in molecular biology and biotechnology.

We are just beginning to comprehend the complex regulatory network involving VSR multiple activities and there are still several unanswered questions. Here we rise some of these questions and thus try to help the “viral silencing suppressor” field move forwards.

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