

## A new regulatory mechanism by small RNAs

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Small RNA emerged as central players in regulating gene expression in all kingdoms of life. As shown in microRNAs and small-interfering RNAs in the RNAi pathway, small RNA suppresses target genes. We sought epigenetic players that regulate defense responses in Arabidopsis, a widely used model plant. Notably, we observed the rapid buildup of a 31 nucleotide-long small RNA, termed as tRF<sup>31Asp2</sup>, derived from Asp-tRNA. Our research revealed that this small RNA is produced by Dicer-Like 1 (DCL1), a known small RNA biogenesis enzyme. tRF<sup>31Asp2</sup> relies on Argonaut 2 (AGO2) and its family protein in regulating defense responses; AGO proteins are common small RNA effector proteins. Interestingly, treating Arabidopsis with tRF<sup>31Asp2</sup> alone led to the activation of over 500 defense genes. This, in turn, conferred immunity against both the bacterial pathogen *Pseudomonas syringae* and the green peach aphid pest. Our targeted mutation analysis found that the effectiveness of tRF<sup>31Asp2</sup> is linked to its specific 5' sequence and the predicted stem-loop structure. Furthermore, our investigation unveiled that tRF<sup>31Asp2</sup> binds to a particular sequence present in defense-related genes and the Gypsy superfamily of LTR-retrotransposons. This discovery introduces a novel positive regulatory mechanism facilitated by a small RNA. The potential applications of tRF<sup>31Asp2</sup> as a tool in biotechnology, not only for plants but also for animals, will be discussed.